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THE NASAL AND PARANASAL CAVITIES OF THE RABBIT IN EXPERIMENTAL WORK
GEORGE KELEMEN, M.D.

RESTORATION OF HEARING IN OTOSCLEROSIS BY TRANSTYMPANIC MOBILIZATION OF THE STAPES
ALAN AUSTIN SCHEER, M.D.

MALIGNANT TUMORS OF THE TEMPORAL BONE
WILLIAM O. LODGE, M.D., ET AL.

HYPOPHARYNGEAL BAR
HANS BRUNNER, M.D.

TREATMENT OF TIC DOULOUREUX BY BLOCK OR SECTION OF THE GREAT AURICULAR NERVE
ALAN L. ROWLAND, M.D.

MAY 1955
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AGING SKIN, A SURGICAL CHALLENGE
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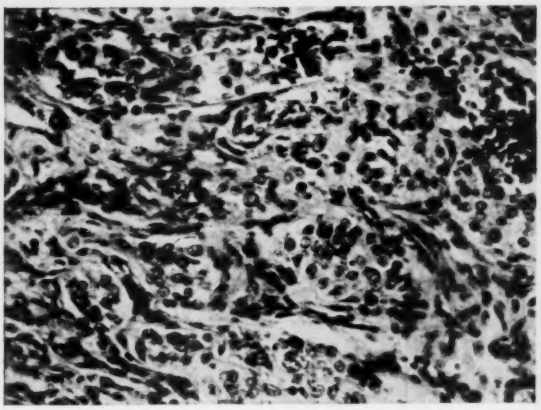

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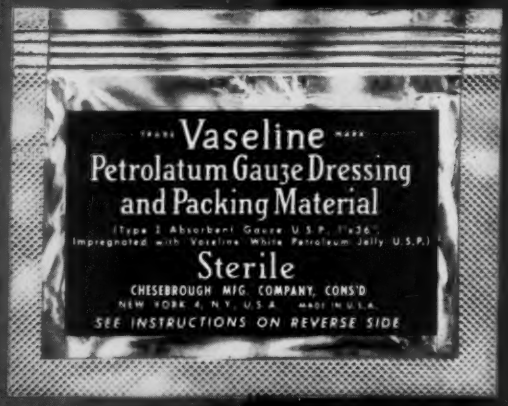
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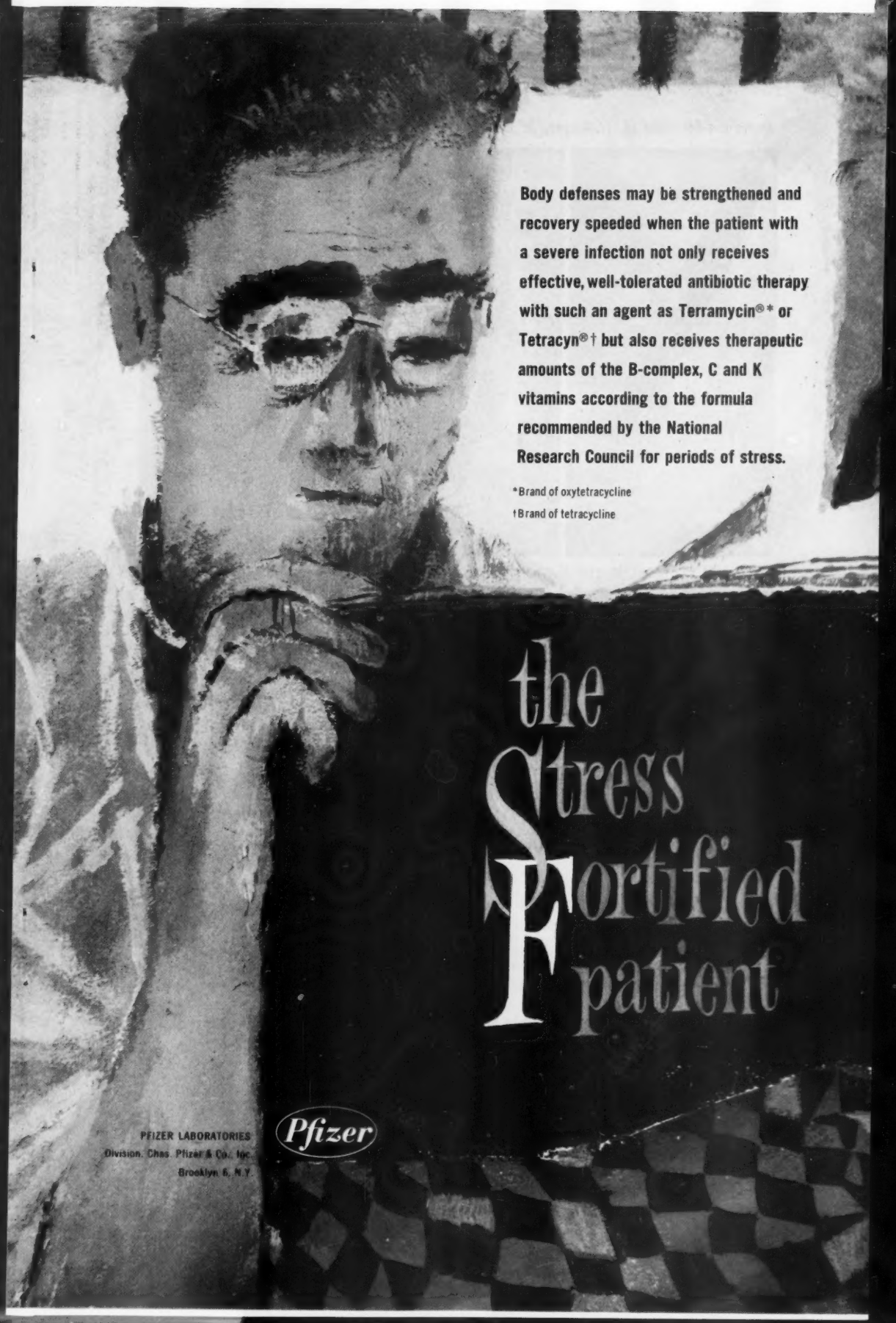
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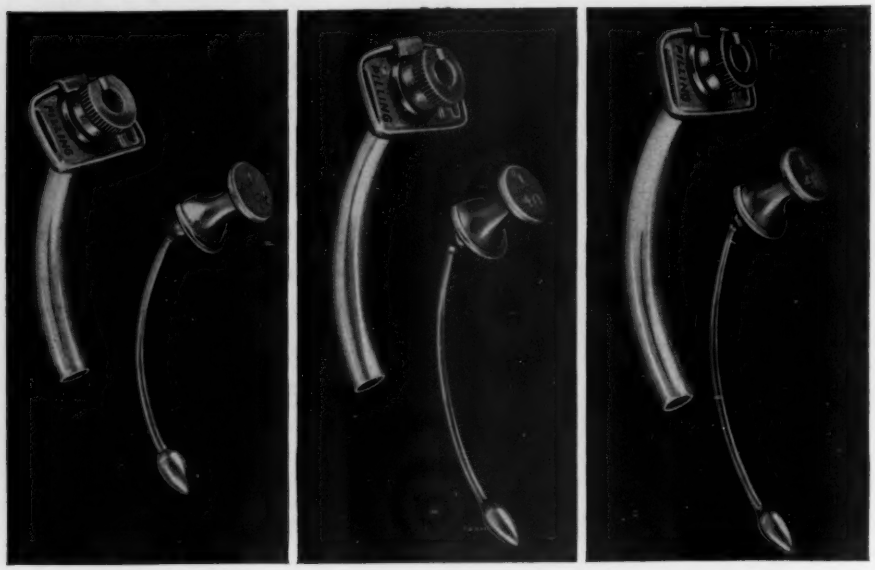

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The Nasal and Paranasal Cavities of the Rabbit in Experimental Work

GEORGE KELEMEN, M.D., Boston

In pursuit of the plan to gain more orientation on (1) normal anatomy and histology of the animal in question and (2) pathological conditions occurring "spontaneously" (i. e., in the course of undisturbed life in the animal farm), the rabbit was studied after the rat and the guinea pig (Bibliography) as the third in this series of laboratory animals. In pharmacological experimentation with intranasal ingestion of drugs the rabbit is in general preferred; in work on the basis of olfactory cues, in experimental psychology, the rat is used more frequently.

Knowledge of the status of the individual animals chosen as controls in experiments is of paramount importance. In the formulation of Kubie (1953), "controls depend . . . upon the meticulous comparison of individuals about each of whom every relevant detail must be known." Hilding (1941) found in apparently healthy rabbits a number with infected sinuses. He advanced the opinion that when a rabbit becomes ill, and debilitated, it seems prone to develop rhinitis and sinusitis; and he advocated more studies regarding the incidence of spontaneous sinusitis.

The nasal cavity of the rabbit was studied, macroscopically and microscopically, by a series of competent workers. The two other most frequently used laboratory animals, the rat and the guinea pig, are rodents; the rabbit is a member of a different order, the Lagomorpha. As such, it has two sets of upper front teeth, one set behind the other, the rodents having a single set. The dental formula of the rabbit is the following: I:2/1; C:O; M:6/5.

From the Department of Otolaryngology, Harvard Medical School, and the Department of Otolaryngology, Massachusetts Eye and Ear Infirmary. Aided by a grant from the William F. Milton Fund, Harvard Medical School, and by United States Public Health Service Grant B-548.

MATERIALS AND METHODS

Eleven albino rabbits (Rice strain), all males, between the ages of 6 and 9 months, of an average weight of 3847 gm., were studied. After macroscopical dissection 1 furnished the basis for orientation by photographs and charts in the sagittal plane, and 10 by serial sections under the microscope. They were sacrificed between the end of January and the first days of March, by insufflation of air in the auricular vein, and the severed heads were placed in Heidenhain's solution. After three days of decalcification with 5% trichloroacetic acid, the blocks containing the nasal and paranasal cavities were roughly adjusted and, after further decalcification, embedded in celloidin. Continuous serial sections were prepared. As finer histological studies were not intended, the thickness of the sections was 15 to 20μ, the aims of a general survey being better served in this way. Every 10th section was stained with hematoxylin and eosin. Slightly more than 1500 sections were obtained and examined. In eight animals the plane of the sectioning was the frontal one; two were cut horizontally, parallel with the bottom of the inferior nasal meatus.

The animals were prepared by Mr. Howard W. Libbey, the histologic work was done by Miss Dorothy Linden, the microphotography by Mr. Richard St. Clair, and the drawings were executed by Mr. William O'Leary.

OBSERVATIONS

A survey of the main pathological findings is given in Table 1, and minor changes will be discussed separately. Localization in the anterior (respiratory), in the posterior (eth-

TABLE 1.—*Pathological Findings in Nasal Cavity and Maxillary Sinus*

No. of Animal	Pathological Finding
1	Secretory catarrh
2	No pathological content
3	No pathological content
4	No pathological content
5	One side: secretory catarrh Other side: ant. part: no pathological content; post. part and max. sinus: suppuration
6	Both sides: suppuration in ant. and post. parts and in the max. sinuses
7	One side: ant. part: fibrinous catarrh; post. part: suppuration; max. sinus: no pathological content Other side: suppuration in ant. and post. parts and in the max. sinus
8	One side: ant. part: suppuration; post. part: no pathological content; max. sinus: no pathological content
9	Both sides: suppuration in ant. and post. parts and in the max. sinuses
10	One side: no pathological content Other side: ant. and post. parts: no pathological content; max. sinus: suppuration

moidal, olfactory, or sensorial) part of the nasal cavity, and in the maxillary sinus is considered, together with unilateral or bilateral occurrence of pathological material.

Table 2 gives a summarized survey of the condition in which the nasal and paranasal cavities were found.

Only three animals were entirely free of pathological changes. One showed a secretory catarrh.

Table 3 shows the distribution of suppuration.

Counting the three main units, suppuration was found in 23 out of 60. This corresponds to 39.3% suppurative infection.

In six cases the nasolacrimal ducts contained clear secretions, in three cases secretions with cellular infiltration. In one case the canal was solidly filled with fibrinous secretion showing cellular infiltration.

These conditions are illustrated by 10 figures. Figures 1 to 4 show photographs of sagittal sections, each with an explanatory drawing; 5 and 6 present a normal frontal and 7 a normal horizontal series; 8, 9, and 10 give examples of characteristical pathological conditions.

COMMENT

The anatomy of the nasal cavity in the rabbit has been described repeatedly and in such detail that only a few characteristics will be here enumerated as forming the basis of the following discussion.

The entire cavity is divided into two parts, one situated behind the other: the anterior (respiratory) and the posterior (ethmoid, olfactory, sensory) portion. The choanal region, with the choanae, which are, according to Bensley (1946), incompletely divided, is situated at the boundary of the two portions. It drains the secretions of the anterior portion in an anteroposterior direction and the secretions of the posterior portion in a posteroanterior direction. Canaveris (1947) emphasized that in the rabbit the inspiratory air follows two pathways, absolutely separated, the inferior being exclusively respiratory, the superior terminating among the ethmoidal turbinates. The important part played by the vomerine ala in the course of the nasal air streams was pointed out by Dawes (1952). According to Proetz (1953), the nasal blanket of mucus in man is discarded at the rate of at least once every half hour. In rabbits, Hilding (1932) found that this mucous layer is changed about once an hour in the anterior and once every 10 minutes in the olfactory part.

TABLE 2.—*Condition of Nasal and Paranasal Cavities*

Condition of Cavities	No. of Cases
Both sides free	3
One side free; other side supp. restricted to sinus	1
Secretory cat. only	1
One side secr. cat.; other side supp. in nasal cav. and sinus	1
Supp. one side in nasal cav.; other side in nasal cav. and sinus	2
Supp. both sides in nasal cav. and sinus	2
Supp. in nasal cav., sinus free, one side	1
Supp., restricted to sinus, one side	1

TABLE 3.—*Topographical Distribution of Suppuration*

Location	Free	Suppuration
Anterior part of nasal cavity	13	7
Posterior part of nasal cavity	12	8
Maxillary sinus	12	8

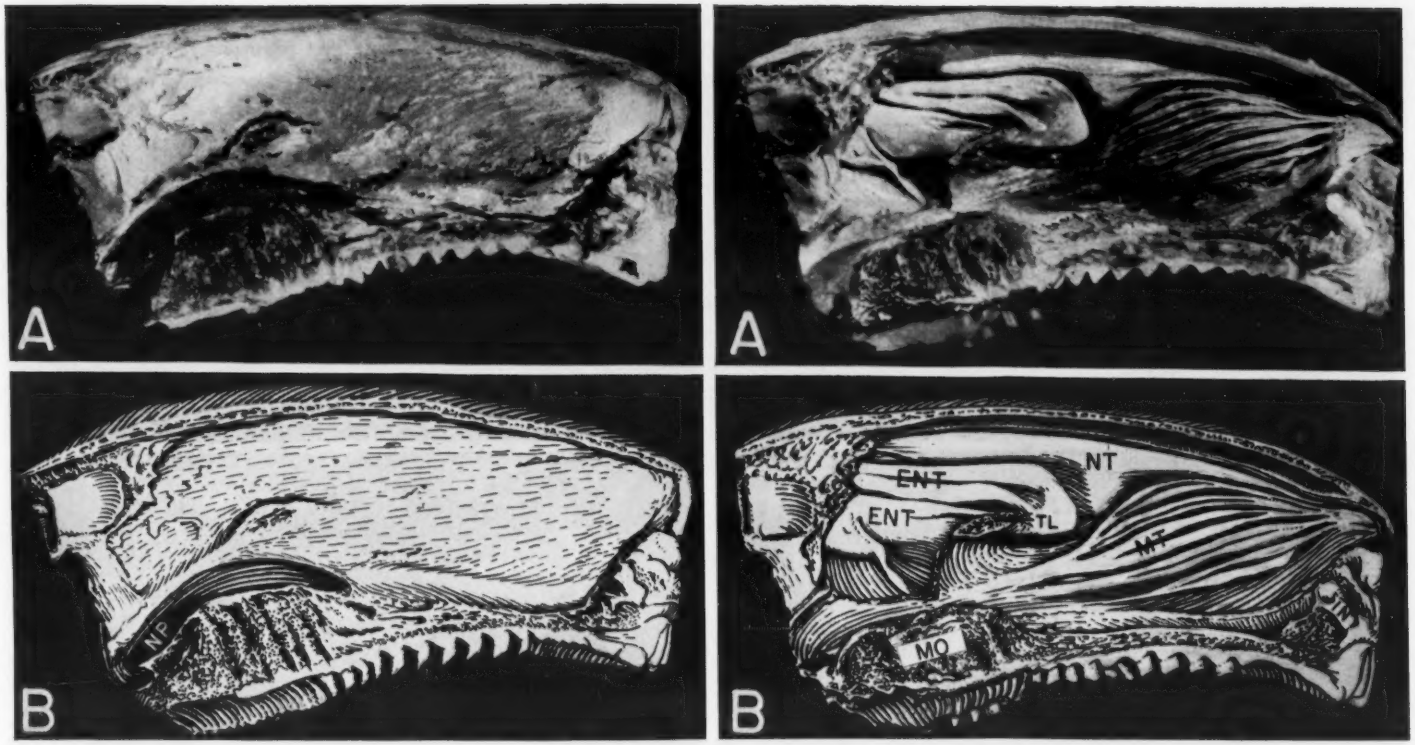

Fig. 1.—Right aspect of the nasal septum after removal of the right half of the nose. *NP*, nasopharyngeal duct.

Fig. 2.—Left lateral nasal wall after removal of the septum. *ENT*, endoturbinals; *MT*, maxilloturbinal; *MO*, molars; *NT*, nasoturbinal; *TL*, terminal lamina.

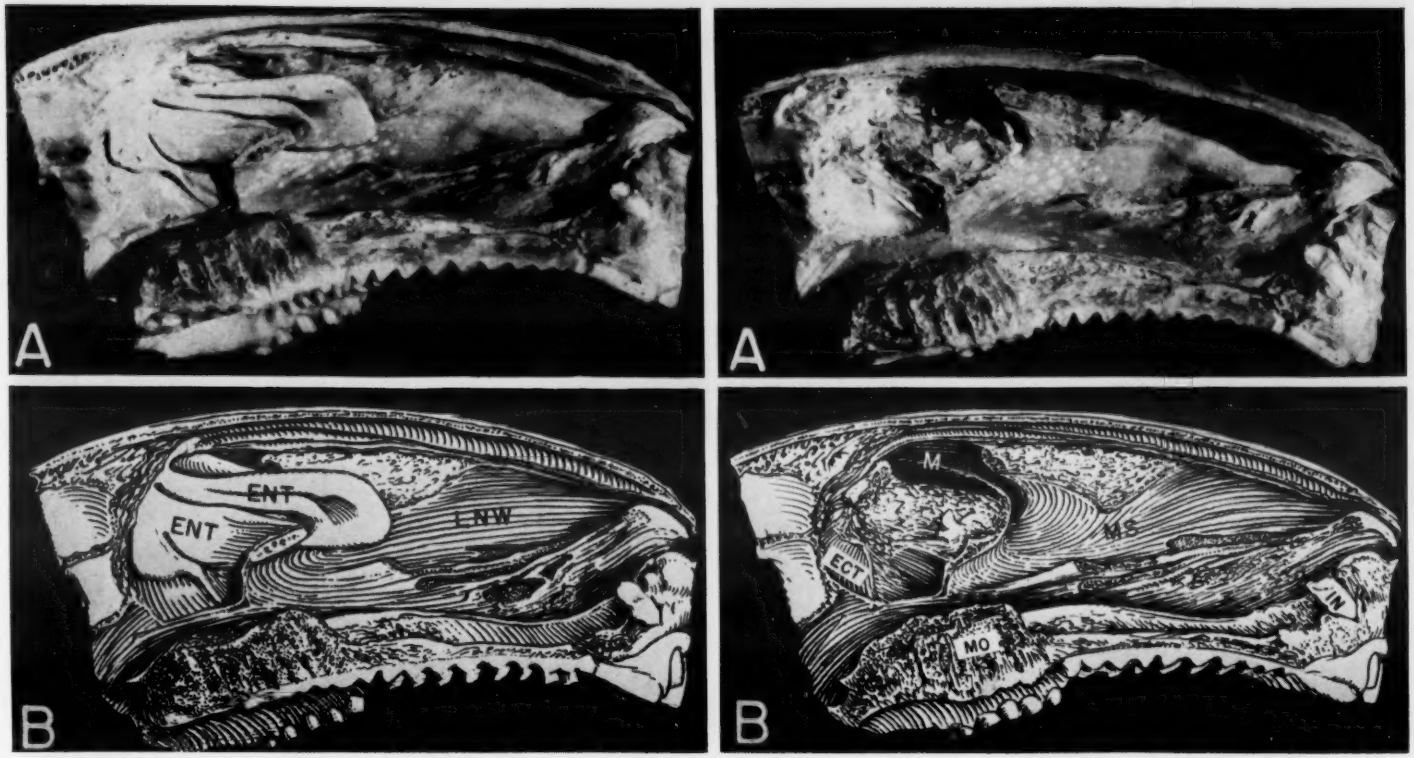

Fig. 3.—Left lateral nasal wall after removal of the nasoturbinal and maxilloturbinal. *ENT*, endoturbinals; *LNW*, lateral nasal wall.
Fig. 4.—Maxillary sinus after removal of the lateral nasal wall. *ECT*, ectoturbinal; *IN*, incisor; *M*, marsupium; *MO*, molars; *MS*, maxillary sinus.

Horizontal sections are more likely to represent the nasal spaces free from secretions, as they divide the area in larger units more apt to be washed free in the course of histological preparation.

One of the peculiarities of the rabbit's nose is the occurrence of areas crowded ad maximum by the full deployment of one of the turbinates in the immediate vicinity of practically empty pockets. The parallel scrolls of the maxilloturbinal, seen in frontal sections in profile as delicate shelves, fill the lower portion of the respiratory part completely.

Regarding the nasal marsupium (pouch), some discrepancy can be noted among the different authors. In the illustrations of Krause (1884) this name is given to the widest, ballooning part of the nasoturbinal in toto, including its external lining. Zuckerkandl (1887) failed to differentiate between maxilloturbinal and nasoturbinal (calling both "nasoturbinal," upper and lower parts) and quoted Krause as to the marsupium, omitting any clear-cut description. Kolmer (1931) called marsupium an entirely different space, namely, that enclosed by the branches of the richly arborescent maxilloturbinal. Bensley (1946) restricted the term to the pouch-like cavity in the widest portion of the nasoturbinal. The present paper follows the terminology of Bensley, calling marsupium the cavity, pouch, formed by pneumatization of the nasoturbinal. This clarification is of consequence, considering the importance of this space in pathology, as will be discussed later.

Besides the turbinals, the respiratory part is narrowed by a cushion, formed by cavernous tissue and running the length of the angle between the septum and the nasal roof (Fig. 5*A*). Together with the nasoturbinal, which extends along the deep aspect of the nasal bone, this cushion transforms the upper portion of the respiratory part into a rather narrow space.

The ethmoid part is filled by its turbinals: four endoturbinals with five olfactory scrolls —first and second endoturbinals fuse into one large olfactory scroll—and four ectoturbinals. The basal lamellae of one or two endoturbinals split into leaves (Paulli, 1899-1900). The olfactory portion is prolonged into the body of the presphenoid with an excavation filled completely by the scroll of the lowest endoturbinal (Fig. 7*A*, *B*, and *C*).

Between the richly arborescent maxilloturbinal and the full ethmoturbinal apparatus, both filling completely their bony capsules, comparatively large empty spaces become conspicuous. Over the ethmoid shelf (terminal lamina) there is a wide tunnel giving access into several regions of the ethmoid part. There is a large open space between the lateral nasal wall, the bottom, and the turbinals of the ethmoid part. But the most conspicuously empty cross section is seen between the respiratory and the olfactory part. Hardly any detail of a turbinal is observed in a frontal section of this region (Fig. 6*A*). The deepest point of the respiratory part is located immediately behind the incisors, where secretions can collect in a flat pool; the deepest part of the olfactory portion is not at the end of the cul de sac, but immediately in front of the molar roots. Over this central area of drainage there is no turbinal apparatus. This disposition might facilitate the collection of a larger quantity of secretion before evacuation. All pockets between the turbinal scrolls have narrow, tortuous exits, and their secretions can drip from all parts into this common receptacle at the boundary of the two main sections of the nasal cavity. Proceeding from the front, the lumen widens here suddenly because it is liberated from the lateral compression by the incisors. The molars, although in intimate topographical relation with the ethmoidal part, do not reduce its lumen, as is done by the incisors in the respiratory part. On the other hand, the very roomy marsupium and the upper recess of the maxillary sinus (the latter here in its maximal expansion) flatten the scrolls of the ethmoturbinals to a considerable extent.

This alternation of narrow defiles with wide, empty pockets is a dominating factor in the spread of infection. A number of "locks" are created. The vestibulum can be

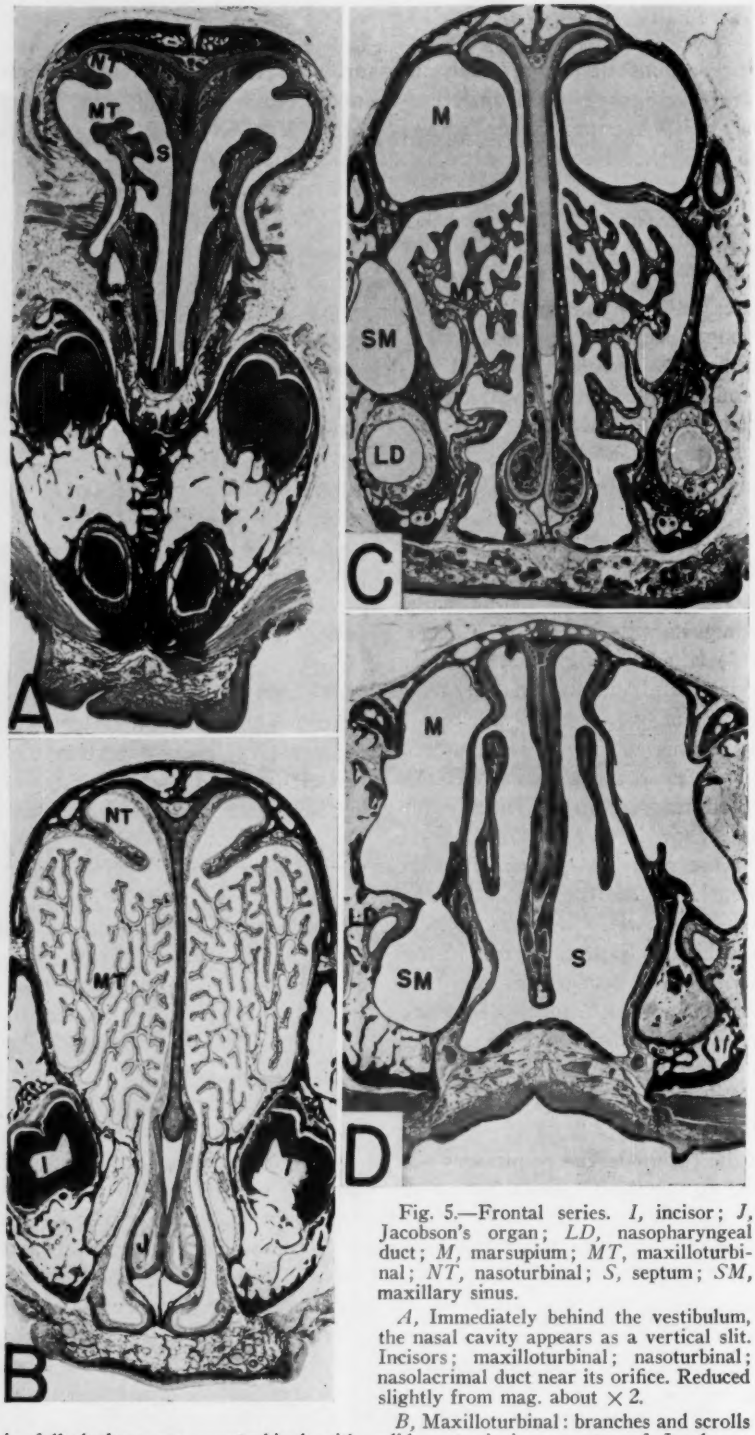

Fig. 5.—Frontal series. *I*, incisor; *J*, Jacobson's organ; *LD*, nasopharyngeal duct; *M*, marsupium; *MT*, maxilloturbinal; *NT*, nasoturbinal; *S*, septum; *SM*, maxillary sinus.

A, Immediately behind the vestibulum, the nasal cavity appears as a vertical slit. Incisors; maxilloturbinal; nasoturbinal; nasolacrimal duct near its orifice. Reduced slightly from mag. about × 2.

B, Maxilloturbinal: branches and scrolls in full deployment; nasoturbinal with solid root; incisor; organ of Jacobson; reduced slightly from mag. about × 2.

C, Nasoturbinal, pneumatized (marsupium); branches of maxilloturbinal; nasolacrimal duct; maxillary sinus; reduced ⅕ from mag. about × 2.

D, Edge of septum free, maxillary sinus and marsupium form a common space; "rosary" of lymph follicles on posterior aspect of velum; reduced ⅕ from mag. about × 2.

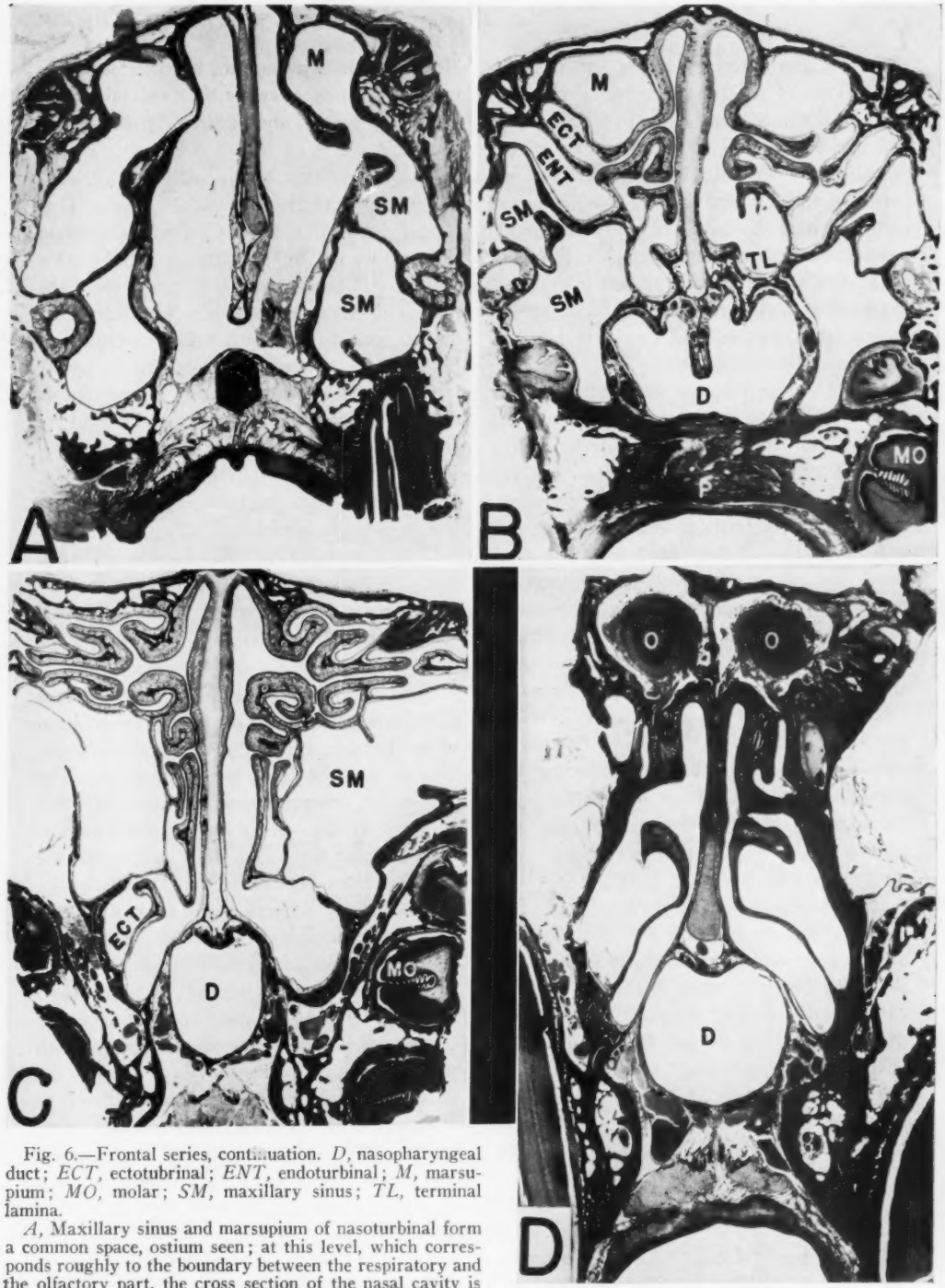

Fig. 6.—Frontal series, continuation. *D*, nasopharyngeal duct; *ECT*, ectotubrinal; *ENT*, endoturbinal; *M*, marsupium; *MO*, molar; *SM*, maxillary sinus; *TL*, terminal lamina.

A, Maxillary sinus and marsupium of nasoturbinal form a common space, ostium seen; at this level, which corresponds roughly to the boundary between the respiratory and the olfactory part, the cross section of the nasal cavity is practically empty, free of scrolls; nasolacrimal duct; reduced ⅖ from mag about × 2.

B, Terminal lamina (shelf) developed; scrolls of ethmoturbinals fill the quadrangular cross section of the cavity. Nasopharyngeal duct completely surrounded by a row of lymph follicles. Reduced ⅓ from mag. about × 2.

C, The cross section of the nasal cavity becomes here triangular, as the molars constrict it from the sides; olfactory scrolls compressed above the very large maxillary sinus, which forms common space with the marsupium and penetrates the nasal bone (the latter can be seen only more frontally from this section); reduced ⅖ from mag. about × 2.

D, Fila olfactoria, medial and lateral group, on their way across the cribriform plate to the olfactory bulb; reduced ⅓ from mag. about × 2.

closed by the anterior pole of the nasoturbinal. This is a bulky, cavernous intumescence, a laterally bent hook (Fig. 7*A* and *B*) fitting the orifice of the vestibule as a stopper. In the following very narrow section, between the convex aspect of Jacobson's cartilage medially and the inward bulging nasolacrimal duct laterally, the smallest amount of secretion will produce a blockage. Penetrating backward, the main passage leads between the septum and the medial scrolls of the maxilloturbinal. Very little material is needed to close off this main thoroughfare and to obliterate the communication to the middle and lateral groups of the maxilloturbinal scrolls.

In the higher section of the respiratory part the cushion in the angle between septum and nasal roof collaborates with the well-developed tuberculum septi to block off the pathway. The medial wall of the marsupium can come into contact with the septum (Fig. 5*C*), while contact between septum and ethmoidal scrolls can be established at numerous points (Fig. 6*B* and *C*). Probably the most important barrier is formed by masses of secretion located above the terminal lamina, right and left of the septal edge, blocking off the entire olfactory box from contact with the anterior parts of the nasal cavity (Fig. 8*D*).

Considering the many points where effective mechanisms can be established to block off portions of the nasal pathways, one has to remember the experiments of Hilding (1932). By closing, surgically, one side of the nose in rabbits, he saw develop structural changes in the columnar epithelium, resulting in disappearance of ciliated and increase of goblet cells; the turbinates on the open side hypertrophied with those of the closed side.

The rabbit has no frontal sinus; there is an air-filled space in the sphenoid and presphenoid, but it is not to be homologized to the human sphenoid sinus. Ethmoidal cells are represented by the open spaces between the ethmoturbinals, and only the nasoturbinal, which does not belong to the ethmoturbinals, carries an air space within its body. This air space, the marsupium, together with the maxillary sinus, is easily the cardinal region in regard to nasal and paranasal pathology in the rabbit.

The marsupium opens with a long, narrow orifice into the ethmoidal capsule. This tunnel is similar to any other connection between the interturbinal spaces and the main meatus. Olfactory fila originate along the medial lining on the outside of the marsupium and come into the immediate vicinity of pathological processes inside the nasoturbinal. The full width of the marsupium is seen in horizontal sections (Fig. 7*A* and *B*; both show the orifice of the marsupium, too). Paulli (1899-1900) characterized it as being very roomy, with the maxillary sinus penetrating into its lumen.

Before turning to the maxillary sinus, it should be mentioned that the maxilla harbors a large marrow space, which in frontal sections can be mistaken for a part of the sinus.

The maxillary sinus is divided into an inferior and a superior or, taking the position of the head in the rabbit into consideration, into an anterior and a posterior recess. The two parts communicate through a wide opening in the partly bony, partly membranous partition. The sinus penetrates the lacrimal bone and is bounded medially by the ethmoid. It opens with an orifice into the pneumatic space in the nasoturbinal, the connection being fully as wide as the other between the two recesses of the sinus itself. Study of frontal sections shows that the two sections of the maxillary sinus, together with the marsupium, form one large cavity; the latter is found, in many frontal sections, to represent a wider area than the main nasal cavity itself. This large lateral cavity is not merely an anatomical but a pathological unit as well; secretions formed anywhere in it can flow easily to any other point of this space. The result is that the entire lateral space—as we shall call it to simplify this presentation—frequently offers the picture of an empyema extending into all its ramifications. In this series, wherever a shunt of secretions was observed between mar-

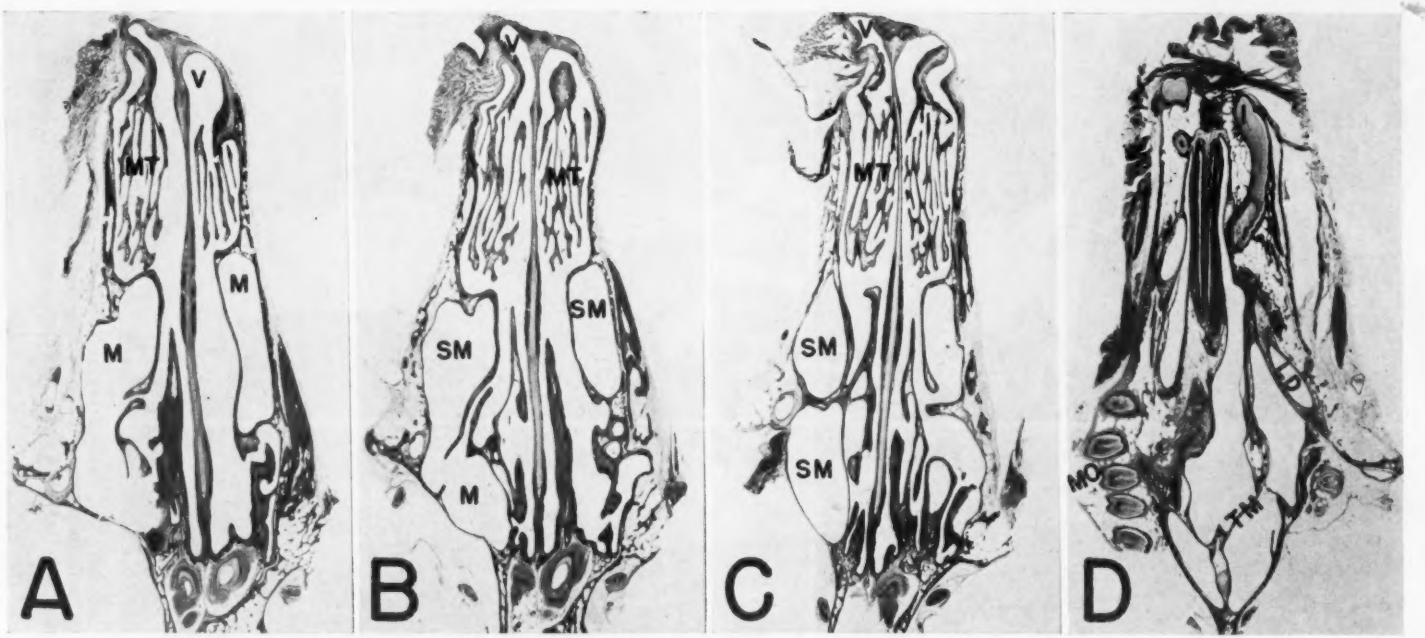

Fig. 7.—Horizontal series. *I*, incisor; *LD*, nasolacrimal duct; *M*, marsupium; *MO*, molar; *MT*, maxilloturbinal; *SM*, maxillary sinus; *TM*, terminal lamina; *V*, vestibulum.

A, Fila olfactoria, medial group, crossing the cribriform plate; marsupium in posterior half of nasoturbinal, merging into a common space with the maxillary sinus; orifice of the sinus; ethmoturbinal; scrolls of the maxilloturbinal in cross section; nasal vestibulum; about × 2.

B, Same as Figure *A*, somewhat lower level; cavernous anterior tip of maxilloturbinal; about × 2.

C, Terminal lamina (shelf) dividing the anterior (respiratory) and posterior (olfactory) half of the nasal cavity; frontally: maxillary sinus, behind it marsupium, the two merging above the shelf; nasolacrimal duct; about × 2.

D, Incisors; molars; nasolacrimal duct pressed against the septum; access to posterior half of nasal cavity very narrow; about × 2.

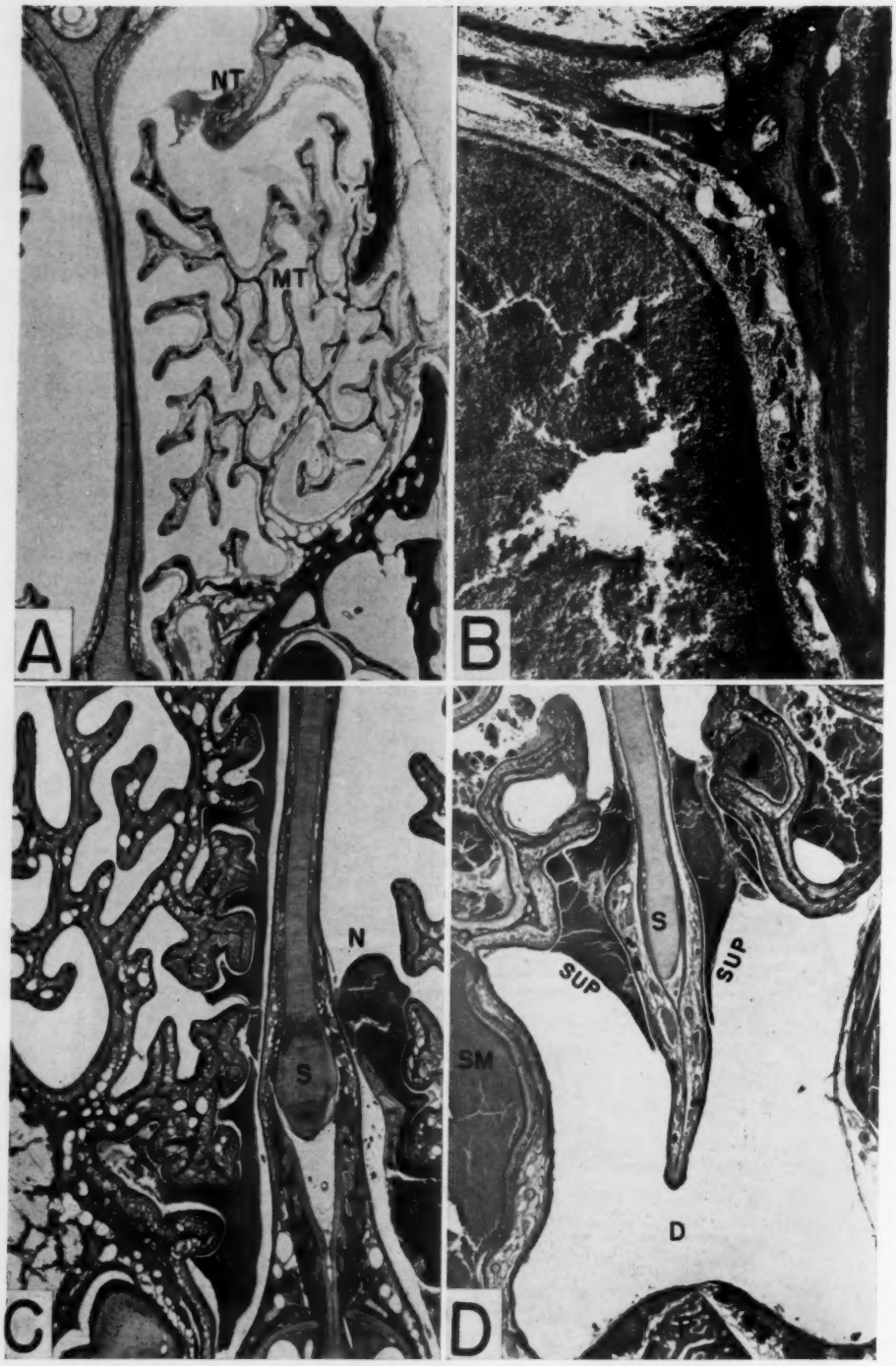

Fig. 8.—Spontaneous pathology. *D*, nasopharyngeal duct; *MT*, maxilloturbinal; *N*, main nasal meatus; *NT*, nasoturbinal; *S*, septum; *SM*, maxillary sinus; *SUP*, suppurative masses.

A, Catarrhal secretions, among branches of the maxilloturbinal, one side; reduced ⅓ from mag. about × 14.

B, Pus, filling solidly the coils of the ethmoidal scrolls; reduced ⅖ from mag. about × 14.

C, Complete blockage of the main meatus in the anterior (respiratory) part by suppuration; reduced ⅜ from mag. about × 14.

D, Blockage of the entrance to the posterior (olfactory) part of the nasal cavitv. above the septal edge, by suppuration; reduced ⅜ from mag. about × 14.

supium and maxillary sinus, it could have taken both directions. It is not necessary to assume propagation of an inflammation to explain the presence of any liquid content in any part of this space.

The lower recess of the maxillary sinus ends about at the level of the bottom of the respiratory part of the nasal cavity, bending down with a slender horn in the direction of the vestibule. The upper recess narrows very rapidly near the cul de sac of the olfactory part, although it reaches a higher level than that of the molars and is free of their pressure.

The orifice of the maxillary sinus is large, in shape a wide slit or canal, in no way similar to the punched-out window of the human anatomy. This canal is similar to all intercommunications within the ethmoidal box. The orifice is covered by the ethmoturbinals and, in horizontal sections, appears at the level of the anterior cavernous pole of the nasoturbinal (Fig. 7*A* and *B*).

The very thick glandular lining of the maxillary sinus can be followed to the upper end of its superior recess, but it is not developed in the marsupium (Fig. 9*C*).

The nasolacrimal duct juts far into the lumen of the lower recess of the sinus (Fig. 5*C* and *D*) but seems to be immune against paranasal pathology. This is the more remarkable, as it is easy to detect in the bony canal wall vascular communications with the lumen of the sinus (Fig. 5*D*; Fig. 9*C* and *D*). The same immunity from pathology of the main cavity characterizes Jacobson's organ, nestling within the hook-shaped cartilage of Jacobson (Figs. 5*B* and *C*, 8*C*, and 9*D*). Both the nasolacrimal duct and the organ of Jacobson are surrounded by a very thick, cavernous venous plexus, which might offer protection by quick adaptation to any inflammatory state. Vascular connections exist between the respiratory part of the nasal cavity and the alveolus of the incisors (Fig. 10*C*) and probably play their role in transmitting pathological material, as is so well known from human pathology. The nasolacrimal duct has intimate relations to all the teeth, as it enters curving from the lateral corner of the nasal cavity over the molars (Fig. 6*A* and *B*) and ends medially of the incisors (Fig. 5*B*).

The nasolacrimal duct showed clear secretion in its lumen, in some cases fibrinous or with cellular infiltration, but never a suppurative infection. Its mucous membrane carries papillary protrusions, sometimes true polyps sitting on solid pedicles. This must correspond to conditions in the living, as shrinking tends to flatten out a preexisting polyp rather than to produce one.

The lymphatic apparatus is an important one, especially around the choanal region. Lymph follicles are seen scattered in the nasal mucosa, as described already by Zuckerkandl in 1893 (although the rabbit was not included in his series). They are distributed within the scrolls, in the wall of the nasolacrimal duct; but the region of the choanal opening claims the highest interest. Here, a complete ring is built in the following way: The lymph follicles on the upper aspect of the soft palate are lined up, rosary-like (Fig. 5*D*), to unite farther back into a solid plate. Together with the follicles found on the lateral choanal walls and in the lining of the inferior aspect of the terminal lamina, a perichoanal lymphatic ring is formed (Fig. 6*B*). As pointed out in regard to the rat and the guinea pig, this ring still awaits detailed study.

Among the manifestations of spontaneous pathology, suppurative processes claim first attention. Pus was encountered filling every cavity, every recess, every tunnel-like communication between turbinal scrolls. Pus can stagnate in the large pocket in the respiratory part of the nose, between the lateral nasal wall and the roots of the maxilloturbinal. It is pasted to the mucous membrane lining (Fig. 8*B*), where, under its action, large sections lose their epithelial covering and are thus transformed into ulcerated areas. Later, in a similar solidly filled space, organization can follow as described in the rat, with fibrosis or reabsorption by new vessels budding out from the submucosa. That organization is less frequent here than in the rat might be explained by easier drainage, the nasal cavity

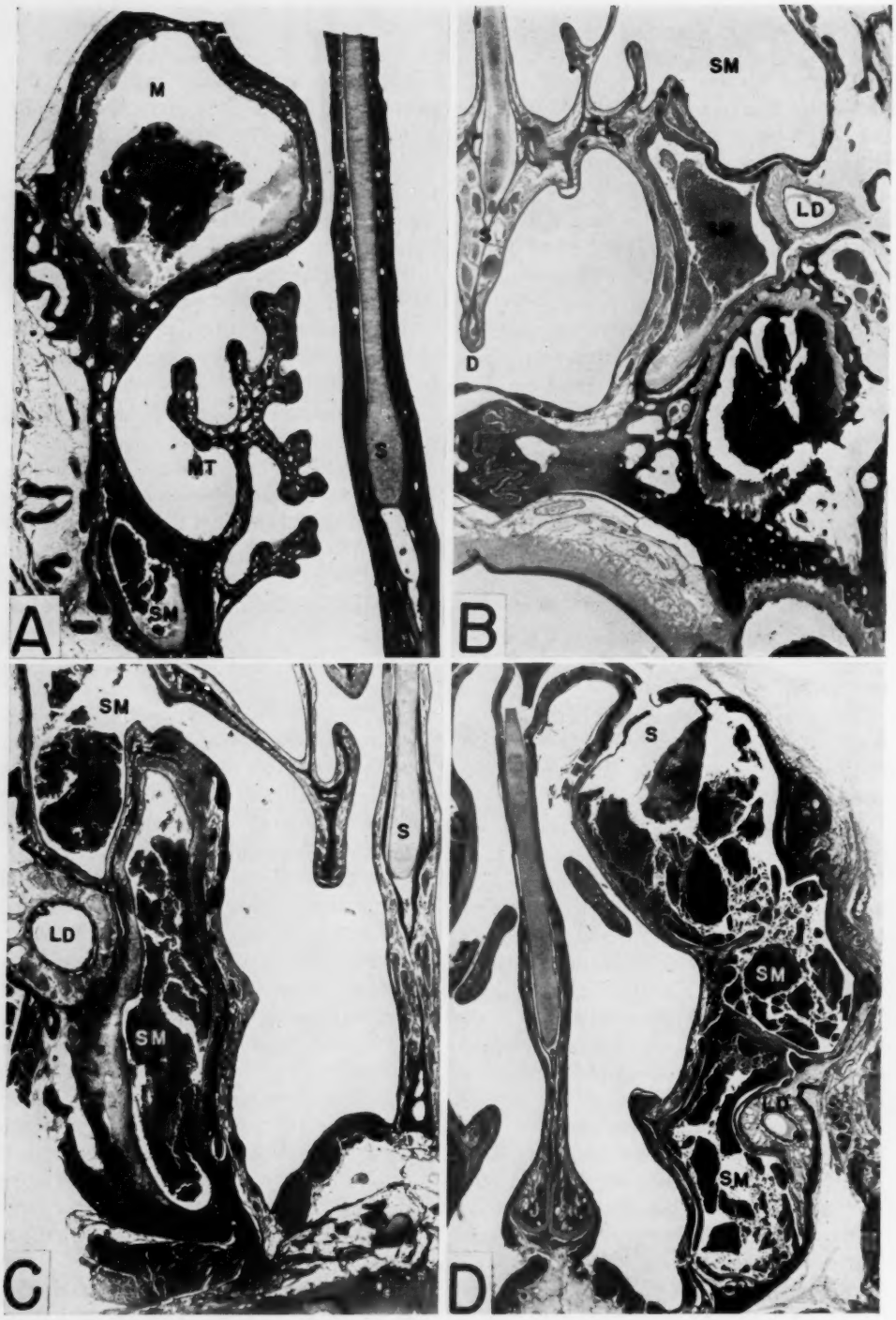

Fig. 9.—Spontaneous pathology. *D*, nasopharyngeal duct; *LD*, nasolacrimal duct; *M*, marsupium; *MT*, terminal lamina; *P*, hard palate; *S*, septum; *SM*, maxillary sinus; *TL*, terminal lamina.

A, Isolated, "hidden" pocket of suppuration in marsupium, one side; reduced $\frac{3}{7}$ from mag. about × 14.

B, Empyema of lower section of maxillary sinus, one side; reduced $\frac{3}{7}$ from mag. about × 14.

C, Empyema of upper and lower section of maxillary sinus, one side; reduced $\frac{3}{7}$ from mag. about × 14.

D, Empyema of marsupium, upper and lower section of maxillary sinus, in continuity, both sides; reduced $\frac{3}{7}$ from mag. about × 14.

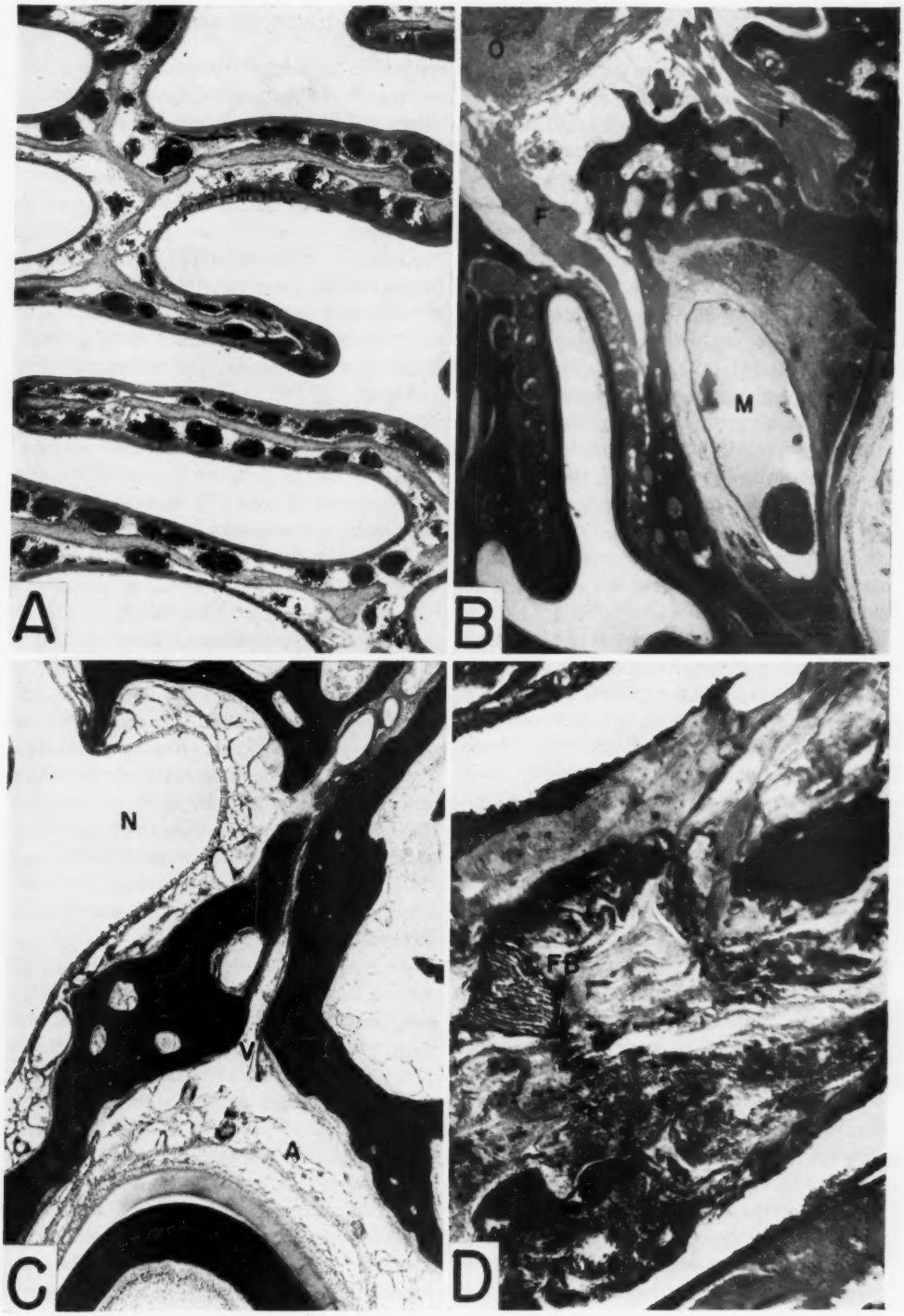

Fig. 10.—*A*, alveolus of incisor; *F*, olfactory fila; *FB*, foreign body (plant material); *M*, marsupium; *N*, main nasal meatus; *O*, olfactory bulb; *V*, vascular channel.

A, Engorged vessels on scrolls of maxilloturbinal; reduced $\frac{2}{5}$ from mag. about × 50.

B, Suppuration in posterior end of marsupium, with olfactory filum originating from its external lining; reduced $\frac{2}{5}$ from mag. about × 50.

C, Vascular canal connecting nasal cavity and dental alveolus; reduced $\frac{2}{5}$ from mag. about × 50.

D, Reactive mass around plant particle as foreign body; reduced $\frac{2}{5}$ from mag. about × 50.

in the rabbit being roomier, with less crowding. In this way suppuration and its consequences can be observed in any form and location without experimental interference.

The same holds regarding different stages of vascular congestion. Dilated, congested blood vessels can be demonstrated anywhere within the nasal cavity, in any distribution, e. g., on both sides of the turbinal scrolls (Fig. 10*A*, among others), and should never be claimed as experimental results. "Frequent adjustments of the circulation to meet the needs of the moment" are possible by the arteriovenous anastomoses found in the nasal mucosa of rabbits (Dawes and Prichard, 1953). Even in the roots of the maxilloturbinal one sees, within the bone, large vessels in delicate ramification, which might play an important role in vasomotor phenomena becoming manifest at the surface of the scrolls.

There is scant justification to claim the presence of goblet cells as being produced by experiment. Without such interference they can be found with great frequency, especially within the maxillary sinus; here the entire epithelium looks sometimes as if composed exclusively of goblet cells. In tissue cultures of nasal mucosa, Fell and Mellanby (1953) have grown, by changing the vitamin A content of the medium, any type of epithelial cells, from ciliated through goblet to squamous form.

Whether true atrophic rhinitis ("metaplasia of the pseudostratified columnar ciliated epithelium, to that of stratified squamous epithelium, thickened basement membrane, stroma with increased fibrosis"), as described by Schall (1944) in humans, can develop spontaneously in the narrow and crowded nasal cavities of rodents or rabbits is so far unknown.

In the tissue culture laboratory of the Institute of Laryngology and Otology, London, it was noticed that not infrequently the nasal mucosa of apparently healthy animals had undergone squamous metaplasia in vivo (Ormerod, 1954).

In the rabbit, the transition of the ciliated epithelium of the nose into the squamous epithelium of the pharynx takes place, according to Bryant (1916), in a zone the anterior border of which extends far in front of the Eustachian orifice, with the posterior border reaching this orifice.

A polyp, high on the septum, was seen in one case.

Richter (1953) registered in his embryological studies great variability in the surface development of the turbinals. He advocated extreme caution in ascribing certain forms to pathologic processes, such as hypertrophy.

Arslan (1928) recorded, in rabbits, development of a mucopurulent rhinitis after insufflation of carbon powder. This etiological factor has to be taken into consideration with animals in captivity in an atmosphere containing this material in large quantities, as in cities or industrial areas.

Seldom is full credit given to the possibility that changes may be caused by nonexperimental factors, as was done by Heine (1936). He applied radium to one side of the rabbit's nose, with the other side left untreated as a control: "The epithelium is hyperplastic in this case. However, considerable evidence of infection is present in this specimen, and it may be a hyperplasia for this reason." Generally one finds only remarks that untreated seemingly healthy animals figured as controls, although it is unlikely that they were free of pathological changes.

Aschan (1948) described the paranasal sinuses in the rabbit as represented by a large maxillary sinus of an exceedingly irregular aspect, the irregularity caused by bony ridges projecting into the cavity, which opens with a single crescent-shaped aperture. In his experiments on aerotitis media and aerosinusitis he paid full attention to spontaneous infections occurring in the rat and the rabbit. By keeping the animals isolated and under observation for a few days and separating the infected ones from the others he succeeded in securing a material free from morphological manifestations of infection.

Without presenting clinical signs, the animals may still harbor severe pathological conditions. Only histologic study can uncover

the real situation. The various pathological entities which go unobserved because of not presenting sniffling, pus discharged from the nares, loss of appetite, and unusual behavior were described in detail by Berberich and Nussbaum (1931). They are acute and chronic rhinitis, with sinusitis, rhinitis contagiosa cuniculorum, rhinitis coccidiosa, and others. Their incidence changes according to the season. Our animals were sacrificed in the winter months; less pathology might have been encountered in a more favorable period of the year.

Experiments were reported on rabbits, with the use of saline in control animals as against the use of the drug under investigation in the others. When these controls were found to be normal, it is quite possible that spontaneous pathological products were simply washed out from the main nasal cavity by the salt solution, although this is less likely to happen in the marsupium or in the maxillary sinus.

It was stated (Butler and Ivy, 1944) that unilateral infection of the upper respiratory tract is seldom seen in rabbits. It was shown here that any single one of the spaces in question can be infected alone. Unilaterality of infection was frequent, making it futile to claim one side as control as against the other used for the experiment.

To reach, with a cannula introduced through the nostril, a given point of the nasal cavity of rabbits is possible only in the anterior, respiratory part. It seems to be impossible, without direct vision, to penetrate with this method into a given section of the ethmoidal part.

Unobstructed access to the surface of the ethmoidal scrolls is essential in experiments of comparative psychology, with behavior studies making use of olfactory cues. The pathway to the olfactory area should not be blocked by intervening masses, and the olfactory membranes should not be damaged by suppuration. In this instance, another factor has to be considered. Baradi and Bourne (1951) have demonstrated in rabbits, by histochemical methods, that the localization of enzymes in and around the elements of the olfactory mucosa suggests an association with the mechanism of smell. Destruction of single anatomical elements in this region may then result in olfactory paresthesias. For behavioral studies one might ask that results be declared as valid only where the animal in question was found, by a following histological analysis, to be free of pathological changes.

The rat and the guinea pig have a "fenestrated" nasal septum, which, from the viewpoint of experimentation, makes a common cavity from the two halves. This circumstance excludes these animals from experiments that use one "untreated" nasal half as a control. In rabbit the septum forms an unbroken partition, but here one encounters other anatomical peculiarities. The anterior (respiratory) part is a separate unit; its secretions do not reach the posterior (olfactory) part, because they are drained off into the pharynx before they reach the ethmoid region. The posterior part forms, with its wide intercommunications, a single pathological unit with the marsupium and through the latter with the homolateral maxillary sinus. The nasoturbinal, not being an ethmoturbinal, still plays, through its pneumatization and its connection with the maxillary sinus, a decisive role in the pathology in a part of the nose to which, anatomically, it does not belong. The lateral space, formed by the marsupium and the sinus, is the dominant area when it comes to the development of morbid changes, the more so because conditions as to drainage are here the poorest.

Disregarding other pathological changes, in the course of our observations regarding the rat, the guinea pig, and the rabbit, suppuration was found in roughly half the animals when examined histologically.

SUMMARY

Ten "healthy" rabbits were taken from an animal farm and examined by continuous serial histological sectioning for spontaneous pathological changes in the nasal and paranasal cavities. Suppuration was encountered in the respiratory part of the nasal cavity seven times, in the olfactory part eight times,

while an empyema of the maxillary sinus was found in eight cases.

Pathological changes were registered in all possible combinations: in single spaces, in all spaces of either side, or in all spaces of both sides.

In pharmacological and behavioral experimentation a number of fallacies can arise with the use, as controls, of animals which are considered to be healthy only because they do not show clinical signs of disease.

414 Beacon St. (15).

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Restoration of Hearing in Otosclerosis by Transtympanic Mobilization of the Stapes

Preliminary Report of Fifty Cases

ALAN AUSTIN SCHEER, M.D., New York

This paper is a preliminary report reviewing the results of 50 cases of clinical otosclerosis treated by the transtympanic method of mobilization of the stapes.

Kessel,[1] Boucheron,[2] Miot,[3] and Faraci [4] had reported cases of otosclerosis in which they tried to mobilize the stapes.

Boucheron (1888) did 60 cases. Miot (1890), who reviewed 200 cases, described in fair detail his technique of applying pressure by a palate-like instrument on the incudostapedial joint.

Rosen,[5] in 1953, described his technique of mobilization, and it is basically his method which was used in operating on the cases which are included in this report. The principle of the operation is to loosen the stapes footplate from its fixed position in the oval window while leaving the ossicular chain intact. With the stapes mobilized in this manner, sound can again be conducted to the cochlea via the physiological ossicular mechanism.

SURGICAL TECHNIQUE OF MOBILIZATION OF THE STAPES

Premedication consists of pentobarbital (Nembutal) (1½ grains [0.10 gm.]) and meperidine (Demerol) hydrochloride (50 mg.). The patient is placed on his back on the operating table, with the face toward the opposite shoulder, thus bringing the selected ear into position. The hair is not shaved. Petrolatum (Vaseline) is applied with a tongue depressor and is used to hold long hair away from the auricle. Regular draping is used, allowing only the ear to be exposed. The entire operation is performed through an ear speculum with the use of a headlight and the Zeiss binocular loop.

A mixture of 2% lidocaine (Xylocaine) hydrochloride (3 cc.), hyaluronidase and epinephrine hydrochloride (1 cc. of 1:1000 solution) is used for local anesthesia. One and five-tenths cubic centimeters of this solution is injected into the soft tissue just external to the junction of the bony and cartilaginous portions of the external auditory canal. A 24-gauge needle is carried down to the bone, and the anesthetic is injected posteriorly and superiorly. It is deposited superficially in the inferior location.

An incision is made in the skin of the bony canal wall 6 to 7 mm. external to the tympanic membrane, extending from 12 o'clock to 6 o'clock on the posterior wall. With elevators of various sizes, the skin is lifted from the bony canal down to the annulus of the tympanic membrane. The fibrous annulus is then lifted out of its sulcus, and the tympanic membrane is folded anteriorly like an apron, thus exposing the middle ear (Fig. 1). If necessary, the posterior-superior bony annular rim is removed with small dental curets. This exposes the entire tendon of the stapedius muscle and the long arm of the incus with its attachment to the head of the stapes. To test for stapes fixation a small curved instrument is placed on the anterior aspect of the neck of the stapes, exerting slight backward pressure in the line with the stapedius

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tendon. If the stapes is fixed, there is no motion of the head of the stapes or the stapedius tendon. Using the same instrument, a greater pulsating force is exerted in the same plane until the stapes and the stapedius tendon begin to move freely. The tympanic membrane and skin of the external canal are folded back and placed in their original positions. The external canal is cleaned, and an external dressing is applied.

In doing the surgery, some of the most striking facts noted are (1) the extent of the local anesthesia obtained, (2) the minimum amount of bleeding, and (3) the excellent visualization of the posterior half of the middle ear. The use of lidocaine (2%) gives a total and complete anesthesia of the external auditory canal, tympanic membrane, and middle ear. If the mixture is properly injected, 1.5 cc., the procedure is completely painless and extremely well tolerated by the patient. Because of the large concentrations of epinephrine used (3 parts lidocaine to 1 part epinephrine), bleeding is minimized. At no time does bleeding interfere with visibility. As a rule, the only time bleeding is encountered is before the tympanic membrane is reflected forward. To insure a dry field, small dental cotton balls occasionally saturated with epinephrine are used as wipes. Narrow-gauge spinal needles (which are beveled flat) are used as suction tips, should they become necessary. By the time the tympanic membrane is lifted out of the annular sulcus, there is no bleeding. Occasionally a drop of blood will get into the middle ear and lodge in the niche of the round window. This can be readily removed with the thin suction tip.

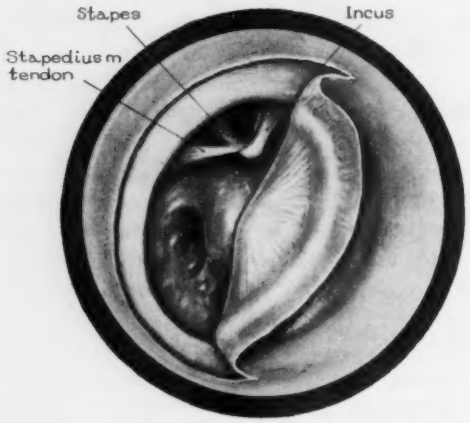

Fig. 1.—The posterior half of the tympanic membrane has been elevated out of its sulcus, thus exposing the incudostapedial joint. This drawing is somewhat diagrammatic to show the stapes, which is normally hidden from view by the incus.

Since the skin of the external canal is thickest in its superior portion, the incision must be started at 12 o'clock, rather than below, since this will prevent tearing. Elevating the skin of the external auditory canal can be done best by starting at 2 o'clock (in the left ear), after the incision has been made. Careful dissection of the skin from the underlying bone is made down to the annular ring in all parts before the middle ear is entered. As the annulus of the drum is lifted out and forward, the thin membranous lining of the middle ear which joins the annulus may still be intact. This will prevent entry into the middle ear, until it is opened. At this point I think it proper to state that it is better to have made the incision a few millimeters too far externally rather than too close to the drum. This is because the skin may fray in its thin lower portion and it will allow sufficient skin to anchor back on the bony external canal wall.

Variation in the contour and diameter of the external canal is a factor to be considered in selected cases. A wide straight canal is the most desirable from the standpoint of operating ease, but it is not essential. As a rule, the size and shape of the canal will determine how much of the incus and stapedius tendon will be immediately visible on lifting the drum. The greater the forward angulation of the canal, the less visible will be the long arm of the incus and stapedius tendon. Occasionally it will not be possible to see even the lower end of the long arm of the incus until the bony annular rim is removed. The majority of cases require that some bone be removed to get the proper exposure. The removal of this bony rim is an

important step in order to obtain adequate visibility and working space. If the curetting is done from within out, there is little danger to the underlying ossicles. All work is done external to the level of the stapedius tendon so that the facial nerve is not endangered. In an occasional patient, part of the horizontal and vertical portions of the facial nerve are visible.

The chorda tympani nerve may be in such a position as to block complete visualization of the incudostapedial joint, so that at times it may have to be severed. Since the nerve stretches, it can usually be pulled away from this critical area. If the nerve is cut against the canal wall with a curet, there is no pain. Should it be picked up, stretched, and then avulsed, there is a short sharp pain that shoots down to the neck and mandible. All precautions to preserve the nerve should be made, since severing it will produce changes in taste quite unlike that obtained after a radical mastoidectomy. All patients in whom the nerve was cut complained the following day about the bitter, metallic taste that remained in their mouths and that food, though in itself tastless on that side, aggravated the bitterness. Of the 10 patients in whom the nerve was sacrificed, 2 still have complaints now lasting over eight months. None of the eight other patients are completely normal, for they are still slightly conscious of some change in taste, but they do not have the constant bitterness in their mouths.

There are three definite variations in the relationship of the lenticular process of the incus with the head of the stapes. On viewing this joint through a speculum, the following is noted: 1. The long arm of the incus may overhang the anterior part of the head of the stapes, allowing the posterior part of the stapes head to be visible. 2. The lenticular process may articulate evenly with the stapes head, so that the latter is not visible. 3. The incus may overlie the posterior part of the stapes, so that the front of the stapes head is visible. The frequency of these positions occurs in the order described, but the third position is relatively infrequent. From the standpoint of mobilizing the stapes, the latter two positions are more desirable. The mobilizer can be more accurately placed, and there is less danger of disarticulating the incudostapedial joint.

The marked variation in the anatomic structure of the stapes explains why one will bear a greater force than another if the pressure is exerted posteriorly on the anterior portion of its neck. Each stapes is structurally different, aside from its basic design. The thickness of the crura varies. Their shapes may differ from the usual pattern of a straight anterior crus and curved posterior crus. Both crura may be straight. The neck may be small or well defined with a definite niche. Examination of a dozen stapes will show one to be much more fragile and brittle than another. These anatomic variations together with the varying degree of fixation will determine whether the stapes can be mobilized.

Examination of a stapes taken from a cadaver will demonstrate the unbelievable amount of force which can be applied to its neck before the crura will snap. This is similarly so in applying pressure to one firmly fixed by otosclerotic pathology. This is true only if the mobilizer is in the correct position on the neck, for if it is on the crus there will be an immediate audible snap (which sounds like the clicking of two fingernails together).

The placing of the mobilizer on the neck of the stapes is done by using the tactile senses and judgment, both of which are gained on the cadaver. This "feel" is necessary, since the anterior crus and neck are rarely visible. Occasionally part of the posterior crus is seen. By gently running the mobilizer up and down the anterior crus, there is a sensation of gripping at the neck, particularly if there is a well-defined notch. By working on the cadaver, one can learn how much pressure can be applied to the normal stapes before it is extracted from the oval window. This knowledge is invaluable before doing a case on the living.

The amount of force that is needed to mobilize a stapes depends on the degree of fixation. Certainly not all stapes can be mobilized. Certain stapes which are fixed can

be moved with slight pressure; others require much more force. There are those which will not give, and finally there will be an audible click signifying that the crura have snapped. I have found that both crura snap together, near the footplate. This was observed in three of the unsuccessful cases where I removed the crura and the head of the stapes after opening the incudostapedial joint, and cutting the stapedius tendon.

The diagnosis of clinical otosclerosis can be made, but there is often no correlation between the decibel loss and the degree of fixation, hence the amount of force necessary to move the stapes will vary. A patient with a hearing loss averaging 45 to 55 db. in most frequencies may have a stapes that moves when moderate force is applied by the mobilizer, whereas, in the opposite ear, or in another patient with this same hearing loss, there may be a bony hard immovable stapes that will fracture. In seven patients in this series the second ear was operated on when the first failed as a result of a too firmly fixed stapes, which fractured. In four cases there was a marked difference in the degree of fixation, allowing the stapes to be mobilized. Three stapes were again found to be too fixed and were again fractured. In the four cases that were able to have the stapes mobilized in the second ear, the audiogram of that ear was similar to that of the opposite, unsuccessful ear.

Slow firm pulsating pressure must be applied to a fixed stapes if it is to be mobilized. It is difficult to continue the pressure for more than five to seven seconds at a time, for the hand which is applying the force must be firm and yet have perfect control of the mobilizer. A fulcrum is necessary to prevent overmoving of the stapes if it is moved. This guidance and absolute control of the instrument in the process of mobilization are essential. It may be necessary to apply this pressure many times before there is any sign that the stapes will move. During this step of the procedure the operator must be constantly watching the instrument and the stapedius tendon. If the stapes moves, there will be a shortening of the stapedius tendon and a change in the light reflecting on it. There is definite stiffness noted in the motion of some stapes after they are mobilized. Continued manipulation of these stiffer-moving stapes does not always make them move any more freely. All of the cases where a maximum hearing result was obtained had a very free-moving stapes. Those cases that had a smaller degree of motion never heard as well.

During the time when pressure is being applied to the stapes, many of the patients, if asked, will state that they hear a drilling noise. This same drilling noise is heard while a mobilized stapes is moved back and forth. It will also be heard if the crura are broken, even though the stapes looks intact and appears to move normally.

I have found that the use of packing in the external canal is unnecessary. Once the skin is laid back along the canal wall, it will not move away unless disturbed. It must be pulled tightly externally to cause the drum to be taut and prevent added retraction after healing.

CAUSES OF FAILURE

Fracture of the crura of the stapes is the most frequent cause of failure. This will always happen if the bony fixation is too great or the stapes is not strong enough to bear the applied force. There is always an audible click when the crura fracture. If pressure is then applied to the neck, it will cause fairly free movement of the head of the stapes and the stapedius tendon. You cannot visualize the fracture of the crura, while looking through the ear speculum, unless the incudostapedial joint is opened. Accurate placement and control of the mobilizer are essential if a greater percentage of crura are not to be broken.

Separation of the lenticular process from the head of the stapes is another cause of failure, even if the stapes is mobilized. This joint opens easily, as is known from experience with the fenestration when the incus is extracted. During mobilization, the mobilizer is placed anteriorly to the long arm of the incus and often direct contact with the incus

cannot be avoided. It is in cases of this sort that the arm of the incus may be pushed posteriorly in advance of the stapes. In extracting the mobilizer through the speculum, care must be taken that the end of the instrument does not flick the end of the incus and open the incudostapedial joint.

Perforation of the tympanic membrane will not appreciably alter a good result, provided that the skin flap is sufficient to hold the drum in place, when it is put back into position.

It is interesting to note that with the drum folded forward after a successful mobilization the patient has improved hearing (provided the reflected posterior half of the drum does not block the sound waves from reaching the intact anterior half). The patient is asked to repeat words of varying loudness to determine if the hearing has improved after the stapes is mobilized. Further improvement in hearing occurs after replacing the tympanic membrane. If after a successful mobilization a drop of blood gets into the niche of the round window, the hearing will drop. After it is removed with the suction tip, the hearing is immediately restored.

In cases where the stapes is so fixed that the operator doubts whether it can be mobilized, I believe that he should continue his attempt to mobilize it, until either it moves or the crura break. Of course, the instrument must be controlled perfectly to prevent extracting the stapes, should it free suddenly. Since the hearing in the cases selected for mobilization is below the 30-db. level, breaking the crura will not make the hearing worse.

POSTOPERATIVE PERIOD

The postoperative period in all cases has not been unusual. The patient is able to sit up in bed immediately after the surgery and have a full meal that night. Most patients do not complain of any pain. Occasionally there is vertigo for one or two hours. Penicillin is given the day of the operation and before discharge from the hospital the next day. One of the oral antibiotics is then given for the next four days. The mastoid dressing is removed on the first postoperative day and the external canal is cleaned. Patients who heard well immediately after surgery may state that within the next few hours a definite drop in the hearing has taken place. This is completely relieved when the serosanguineous fluid is removed with a suction tip, exposing the tympanic membrane. Generally this does not recur beyond a period of four days. Care is taken not to let the suction tip touch the tympanic membrane. The anterior half of the tympanic membrane may have a good luster when seen at the first dressing, but the posterior half is usually quite injected. At the first dressing, cotton is put into the external canal and the patient is advised to change it as often as necessary. A coagulum of blood seals over the area of the incision. This hardens to form a hard crust, which can be readily removed between the third and fourth weeks. The tympanic membrane assumes a normal appearance between the second and third weeks. It is occasionally more retracted than before the surgery. When healing is complete, the skin of the external canal is normal. There is no scar visible where the original incision was made.

COMPLICATIONS

In the 50 cases which are being reviewed in this preliminary report there were no real complications.

Four cases developed an infection within five days of the surgery. These ears were dry within three weeks after the antibiotics were increased. There were four ears with traumatic perforations of the tympanic membrane, of which two became infected. All of these perforations healed spontaneously within three weeks. Careful removal of all loose bony spicules which may catch under the flap is important, since these will act as sequestra.

In no case was the stapes avulsed from the oval window, nor were there any untoward labyrinthine symptoms. Two patients complained of vertigo when the stapes was mobilized, and there was nystagmus, which lasted a few moments.

Trauma to the facial nerve has been completely avoided and should never occur if proper care is exercised.

HEARING RESULTS IN FIFTY CASES WITH A SIX- TO TEN-MONTH FOLLOW-UP

In the mobilization operation either the stapes is mobilized or it is fractured. If it is fractured, there is no improvement in hearing. The cases that are successfully mobilized can be divided into two groups: Group A, where there is a very marked improvement in hearing, and Group B, where there is little or no improvement. In this series of 50 cases 47 stapes were found to be fixed at the time of surgery; 3 stapes were found mobile at the time of surgery; 16 stapes had their crura fractured, and 31 stapes were successfully mobilized.

Of the 31 stapes that were mobilized, the following was found:

Fifteen of these cases fall into Group A.

Sixteen of these cases fall into Group B.

If the stapes is completely mobilized, one could expect that the air conduction might reach the preoperative bone-conduction level. This is evidently true if the normal ossicular conduction is restored. Of the 15 cases classified as Group A, 7 had air conduction that reached the preoperative bone-conduction level. The eight remaining cases in Group A had marked improvement above the practical 30-db. level, but the air conduction did not attain the bone-conduction level.

In the 15 Group A cases, the return of hearing in the operating room was often dramatic. As soon as the stapes was mobilized, these patients noted an increase in volume of the spoken voice and various noises in and outside of the room. It was an emotional moment for many of the women. Two patients who spoke with very low voices before the return of their hearing were noted to have an increased volume in their speech immediately following the procedure.

At the time of this preliminary study, the reason for failure to obtain a greater hearing improvement in the mobilized Group B patients can only be speculated. It is reasonable to think that if a stapes has been fixed about a large portion of the perimeter of the footplate the irregularity of the fractured area (if it actually is a fracture) would prevent normal movement of the stapes within the oval window, even after mobilization. This would certainly be true if the annular ligament holding the stapes in the oval window or the footplate had been replaced to any extent by the otosclerotic process. It could not be expected to vibrate normally unless the fracture line through the otosclerotic process was linear and regular in type, or if the area of disease causing the fixation was small.

Complete hard bony fixation accounted for the 16 stapes that were fractured. This firm fixation is easily transmitted into tactile sensation by the delicate mobilizer.

Of the 31 stapes that were mobilized, there was marked variation in the degree of fixation. The majority of the stapes (29) were gradually worked loose with pulsating pressure. Two stapes became free suddenly as a result of rather marked pressure. These two cases are in Group A and have maintained their hearing improvements for 10 months. Thirteen of the patients where the stapes were gradually loosened are in Group A. The freely mobile stapes produced better hearing than those which, though mobile, were somewhat stiffer in their movement.

If clinical improvement in hearing was obtained, it was always noted at the time of the surgery. The maximum audiometric improvement was always obtained within five days unless a clot remained in contact with the tympanic membrane. Several patients in whom the crura were broken stated that they heard better, but the audiograms showed no improvement. One patient in whom the stapes was mobilized suffered a further loss of 15 db. in all frequencies.

Of the 15 patients in Group A, 12 have maintained their original hearing results for a period of time varying from 6 to 10 months. Two have had a sufficient drop to offset all of the original gain. In one patient there was a loss sufficient to be noticed but still the air

conduction remained much improved over the preoperative level. This loss progressed gradually over a three-month period and then remained stationary.

The two cases where the hearing returned to the preoperative level did so within a period of one month. One ear developed a postoperative infection, and the loss was quite rapid. The hearing did not return when the infection cleared. (This has been observed in two cases outside of this series.)

The two patients in Group A whose hearing dropped to the preoperative level after successful mobilizations had revisions. The same surgical procedure was done again. The skin of the posterior canal wall elevates more easily the second time, because it is slightly thicker and not as adherent to the underlying bone. The drum folds forward more easily, because the annulus does not have to be lifted out of its sulcus. Since all the bony annular rim necessary for the proper exposure has been removed at the original operation, this secondary procedure becomes more simplified. Both cases that were revised were noted to have recurrence of stapes fixation. In addition, one case had a heavy fibrous band between the incus and the medial surface of the tympanic membrane. After this band was severed, the stapes was still quite fixed. Each stapes was found to be as fixed as at the original procedure, but could be remobilized. The hearing in each case was returned to approximately the same level that had been attained with the first mobilization.

In seven cases, where the original mobilization had failed (because the stapes was fractured), the opposite ear was attempted. Three cases were again unsuccessful because the stapes was too fixed, and fractured. Four cases were successfully mobilized. Of those mobilized, one was a Group A result and three were Group B.

A fenestration operation was performed on one patient who had a bilateral mobilization which was unsuccessful (fractured stapes). The fenestration was performed on the ear nine weeks following the mobilization, at which time the skin of the external canal was completely healed and the drum had a normal luster. There was no unusual difficulty encountered in preparing the tympanomeatal flap or at any time during the surgery. The improvement in hearing is very satisfactory. Despite the fact that only one fenestration was performed following an unsuccessful mobilization, I believe that other cases should be no different, provided the tympanic membrane is intact and the skin of the external canal is completely healed.

In this series of 50 cases were 5 that had had previous fenestrations in one ear. Three cases had their stapes fractured. Two stapes were mobilized, but only one patient obtained any improvement in hearing. The second case where the stapes was mobilized was noted to have a complete closure of the round-window niche. In its place was a small porous area. Only one other ear in this series had a narrowing of this niche.

Several patients in this series had bone conduction near the 30-db. level in the middle frequencies and occasionally were below this at the 2048 frequency, yet they were able to enjoy enough hearing improvement, so that it made a tremendous difference. This composes a large group of patients who before this had no alternative except a hearing aid, since a satisfactory result could not be obtained with a fenestration.

The following pertinent facts have been learned from this series and from other later cases not included in this preliminary report.

1. No correlation was noted between the age of the patient or the duration of the hearing loss with the degree of stapes fixation.

2. When the Rinne test was negative with the 512 fork but still equal (AC=BC) with the 1024, it was observed that the stapes was not completely fixed and could usually be mobilized.

3. If both the 512 and 1024 tuning forks give a negative Rinne test but the patient can still hear a moderately loud voice, the stapes will be firmly fixed but can often be mobilized.

4. If in the presence of a negative Rinne test with the 512 and 1024 forks the patient has difficulty even in hearing a very loud

voice, the stapes will be too fixed to be able to be mobilized.

The cases that will have the greatest percentage of good results are in the group that have a negative Rinne test with the 512 fork but still have an equal response with the 1024 fork.

From the patient's point of view, the mobilization procedure is certainly less to endure than the fenestration. The operation is of short duration under local anesthesia as opposed to the usual general anesthesia of longer duration. The hospital stay is shorter, with a considerable saving of expense. A faster return to work may be economically important. The recovery period is shorter and does not have the vertigo that disturbs some patients after fenestration. The constant cleaning of the fenestrated ear and its occasional infections are avoided. There are some patients who for reasons of their own will not undergo fenestration. These patients have been anxious to undergo mobilization.

That group of patients who are physically and emotionally unacceptable for fenestration now are suitable for mobilization, since it is a much less strenuous and trying procedure for them.

REPORT OF CASES

CASE 1.—L. R., a 37-year-old woman, had noted a bilateral progressive loss for eight years. There was no family history or background of aural infections. Tinnitus was present in both ears, more marked in the left. There was definite paracusis. Eustachian tubes were patent. The left stapes was found to be fixed and was mobilized on March 4, 1954, with a sudden return of hearing. She was not aware that she was five weeks' pregnant at the time of the operation. During the course of and after the pregnancy, the hearing improvement was maintained. The tinnitus has subsided in the left ear. Figure 2 is an audiogram done nine and one-half months after mobilization.

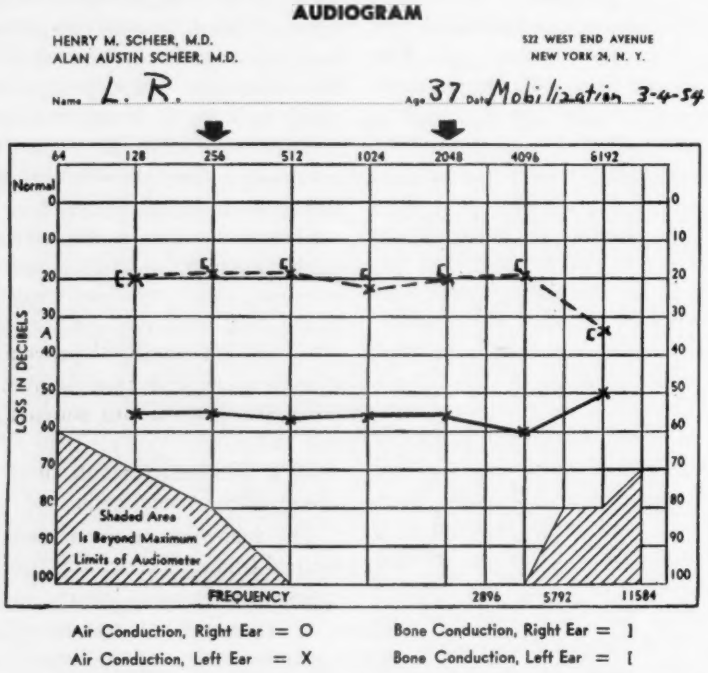

Fig. 2.—The solid line indicates the air conduction prior to mobilization. The dashed line indicates the air-conduction audiogram taken nine and one-half months after the surgery.

CASE 2.—K. M., a 42-year-old white woman, had a progressive bilateral hearing loss over a period of 10 years. The loss in the left ear was not as advanced as in the right ear. Tinnitus was present in both ears, but no paracusis. Both tympanic membranes were normal and Eustachian tubes patent.

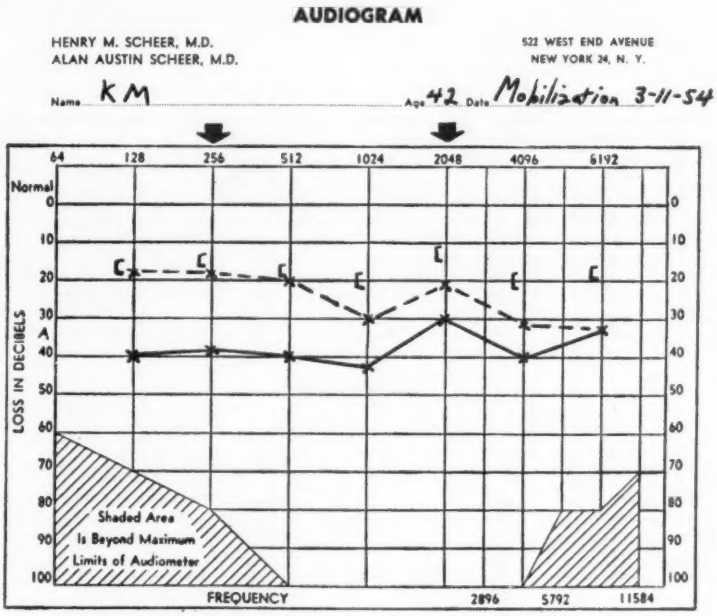

Fig. 3.—The solid line indicates the air conduction of the left ear prior to mobilization. The dashed line shows the air-conduction audiogram nine and one-half months after the mobilization of the stapes.

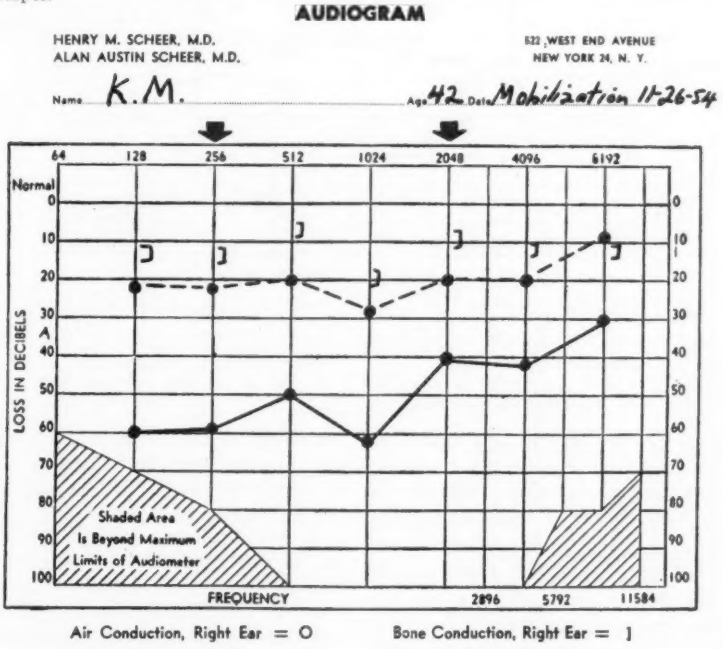

Fig. 4.—The solid line shows the air conduction of the right ear before mobilization (same patient as in Figure 3). The dashed line shows the air conduction one month after mobilization. The mobilization of this ear is not included in the statistics of this report because the surgery is too recent to be evaluated, but it is of interest, since it is a bilateral result.

Audiometric studies and tuning-fork tests indicated a conductive-type deafness. The left stapes was exposed on March 11, 1954, and found to be moderately fixed. When it was mobilized there was a definite improvement in the hearing. An audiogram taken on Dec. 17, 1954, shows that the hearing has been completely maintained. The right ear, which had been the worse ear, was operated on Nov. 26, 1954. This operation is not included in the statistics of this preliminary report. The stapes was found more firmly fixed than that of the left ear, but was mobilized and made freely moveable. Audiometric studies done on Dec. 17, 1954, are included. See Figures 3 and 4.

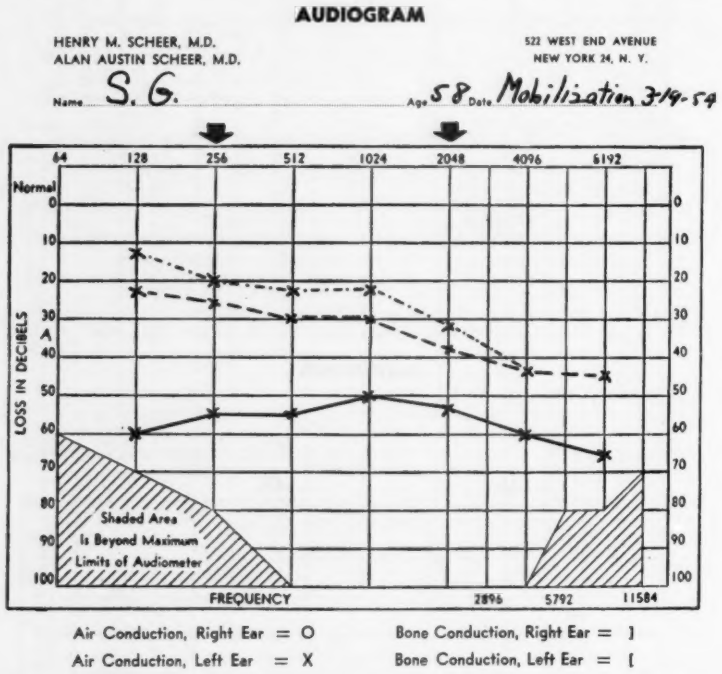

Fig. 5.—The solid line indicates the air conduction prior to mobilization. The dot-dashed line shows the immediate postoperative result. The dashed line indicates the air conduction three months following the surgery. This has now been maintained at the same level nine months after the mobilization of the stapes.

Case 3.—S. G., a 58-year-old man, had a bilateral hearing loss for 20 years. He had worn a hearing aid for the last eight years. Audiometric studies indicated a conductive deafness. Bone conduction was above the 20-db. level for all frequencies up through the 1024, but at the 2048 frequency was at the 33-db. level. On March 19, 1954, the left stapes was found to be fixed and was successfully mobilized. The air conduction reached the preoperative bone-conduction levels. The hearing aid was discarded. During the next three months the tinnitus returned to its original intensity and there was a gradual loss of 10 db. in all major frequencies. There has been no further change since July, 1954. The most recent audiogram was done on Dec. 18, 1954. See Figure 5.

Case 4.—V. A., a 36-year-old white man, had a 10-year history of a hearing loss. He had worn a hearing aid for four years in his left ear. He had never had any tinnitus or previous ear infections. Paracusis was noted. Tympanic membranes were completely normal, and Eustachian tubes were patent. The left ear was operated on March 26, 1954. The stapes was exposed and found to be extremely fixed. The mobilizer was applied several times with firm pressure, sufficient to bend the instrument slightly. The improvement in hearing was dramatic when the stapes was mobilized.

During the next five months immediately following the surgery there was a drop of 10 db. in the lower and middle frequencies. There was no further loss during the following five months, as is indicated on the most recent audiogram, taken on Dec. 20, 1954. On Dec. 3, 1954, the right stapes was exposed and found to be extremely fixed. It mobilized gradually and became freely moveable. (The mobilization of the right stapes is not included in the statistics of this preliminary report.) See Figures 6 and 7.

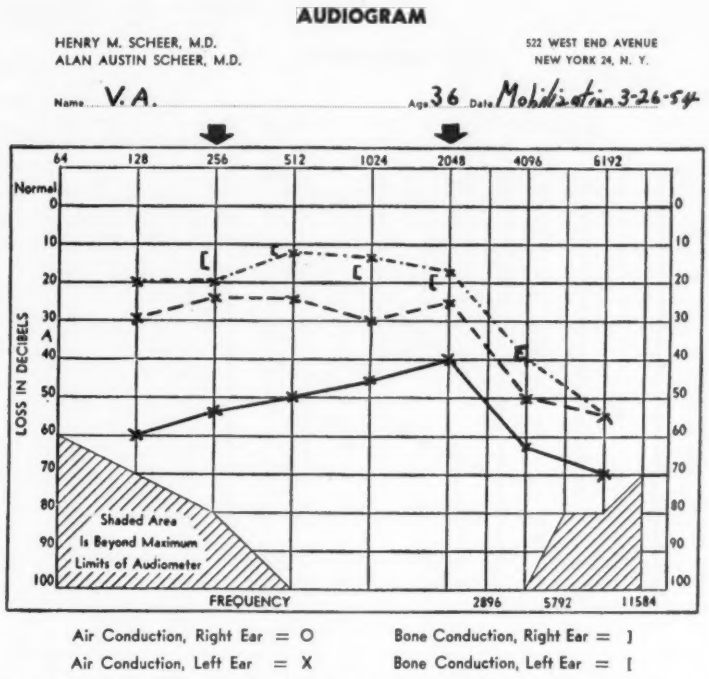
AUDIOGRAM
HENRY M. SCHEER, M.D.
ALAN AUSTIN SCHEER, M.D.
522 WEST END AVENUE
NEW YORK 24, N. Y.
Name V. A. Age 36 Date Mobilization 3-26-54
64 128 256 512 1024 2048 4096 6192
Normal
LOSS IN DECIBELS
Shaded Area
Is Beyond Maximum
Limits of Audiometer
FREQUENCY
2896 5792 11584
Air Conduction, Right Ear = O
Air Conduction, Left Ear = X
Bone Conduction, Right Ear =]
Bone Conduction, Left Ear = [

Fig. 6.—The solid line indicates the air conduction prior to mobilization of the stapes. The dot-dashed line shows the immediate postoperative result. The dashed line indicates the air conduction five months following the surgery. This hearing has been maintained at this level nine months after mobilization.

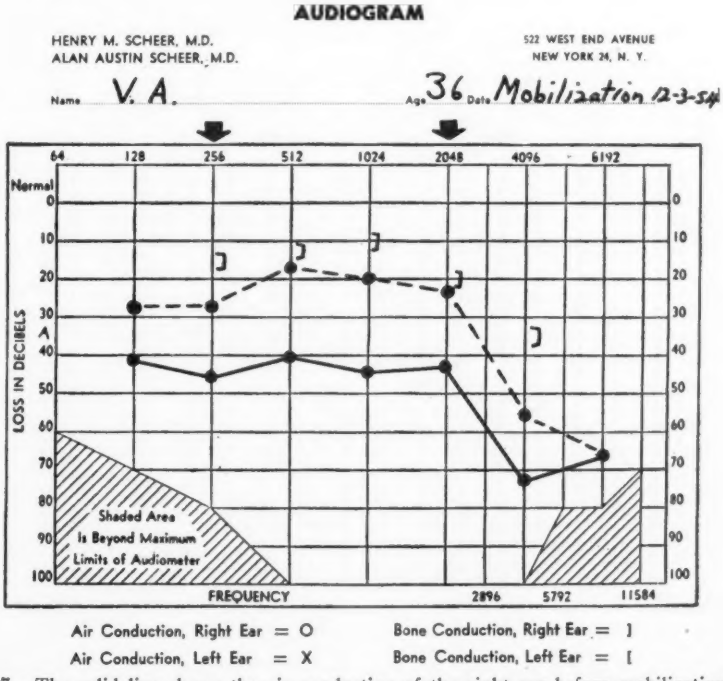
AUDIOGRAM
HENRY M. SCHEER, M.D.
ALAN AUSTIN SCHEER, M.D.
522 WEST END AVENUE
NEW YORK 24, N. Y.
Name V. A. Age 36 Date Mobilization 12-3-54
64 128 256 512 1024 2048 4096 6192
Normal
LOSS IN DECIBELS
Shaded Area
Is Beyond Maximum
Limits of Audiometer
FREQUENCY
2896 5792 11584
Air Conduction, Right Ear = O
Air Conduction, Left Ear = X
Bone Conduction, Right Ear =]
Bone Conduction, Left Ear = [

Fig. 7.—The solid line shows the air conduction of the right ear before mobilization (same patient as in Figure 6). The dashed line shows the air conduction three weeks after mobilization. This mobilization is not included in the statistics of this report, since the surgery is too recent to be evaluated, but it is of interest because it is a bilateral result.

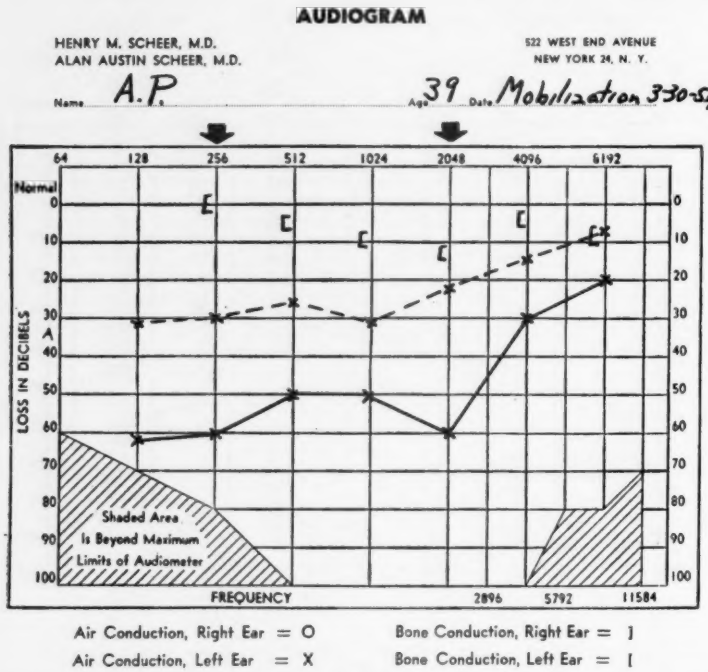
AUDIOGRAM
HENRY M. SCHEER, M.D.
ALAN AUSTIN SCHEER, M.D.
522 WEST END AVENUE
NEW YORK 24, N. Y.
Name A.P. Age 39 Date Mobilization 3-30-54
64 128 256 512 1024 2048 4096 6192
Normal
LOSS IN DECIBELS
Shaded Area
Is Beyond Maximum
Limits of Audiometer
FREQUENCY
2896 5792 11584
Air Conduction, Right Ear = O
Air Conduction, Left Ear = X
Bone Conduction, Right Ear =]
Bone Conduction, Left Ear = [

Fig. 8.—The solid line indicates the air conduction before mobilization of the stapes. The dashed line shows the air conduction eight and one-half months after the surgery.

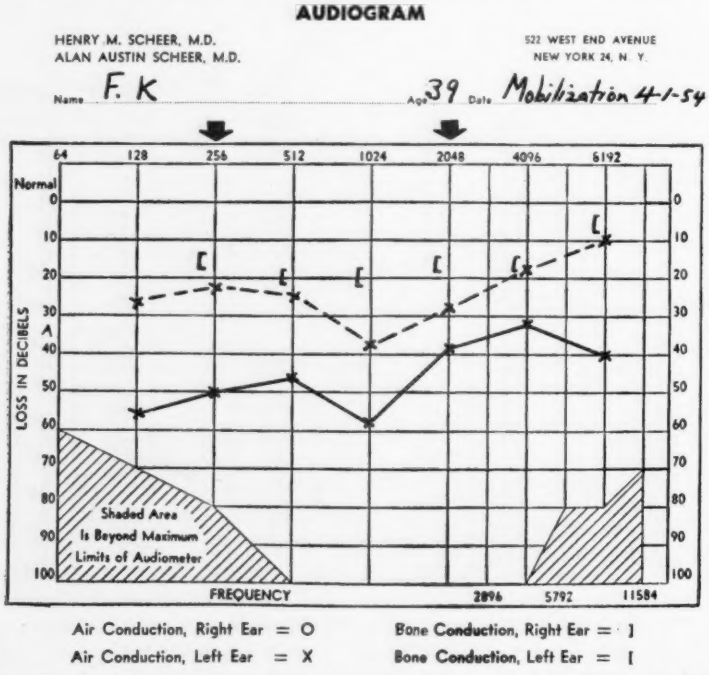
AUDIOGRAM
HENRY M. SCHEER, M.D.
ALAN AUSTIN SCHEER, M.D.
522 WEST END AVENUE
NEW YORK 24, N. Y.
Name F. K Age 39 Date Mobilization 4-1-54
64 128 256 512 1024 2048 4096 6192
Normal
LOSS IN DECIBELS
Shaded Area
Is Beyond Maximum
Limits of Audiometer
FREQUENCY
2896 5792 11584
Air Conduction, Right Ear = O
Air Conduction, Left Ear = X
Bone Conduction, Right Ear =]
Bone Conduction, Left Ear = [

Fig. 9.—The solid line indicates the air conduction of the left ear prior to mobilization of the stapes. The dashed line indicates the air conduction eight and one-half months after the surgery.

CASE 5.—A. P., a 39-year-old white woman, noted a bilateral progressive loss of hearing 15 years ago, after the birth of her second child. There was no paracusis or tinnitus. No family history of deafness. Eustachian tubes were patent. Tympanic membranes were normal in appearance. The left stapes was found to be fixed on March 30, 1954, and was successfully mobilized, with improvement in hearing. The hearing has been maintained in all frequencies, as of Jan. 6, 1955, nine and one-half months after the surgery. See Figure 8.

CASES 6 and 7.—F. K., a 39-year-old white woman, noted a bilateral progressive loss of hearing loss. Tinnitus and paracusis had been present for several years. Her mother has had a hearing loss since her early 30's. Eustachian tubes were patent, and the tympanic membranes appeared to be slightly thickened. Preoperative bone conduction in the left ear was at the 25- to 30-db. level in all frequencies. The stapes was found to be fixed on April 30, 1954, and was successfully mobilized. Air-conduction levels approximated the bone-conduction level on the audiogram taken one day postoperatively. During the following month, air conduction receded almost to the preoperative level. On June 30, 1954, a revision was done and the

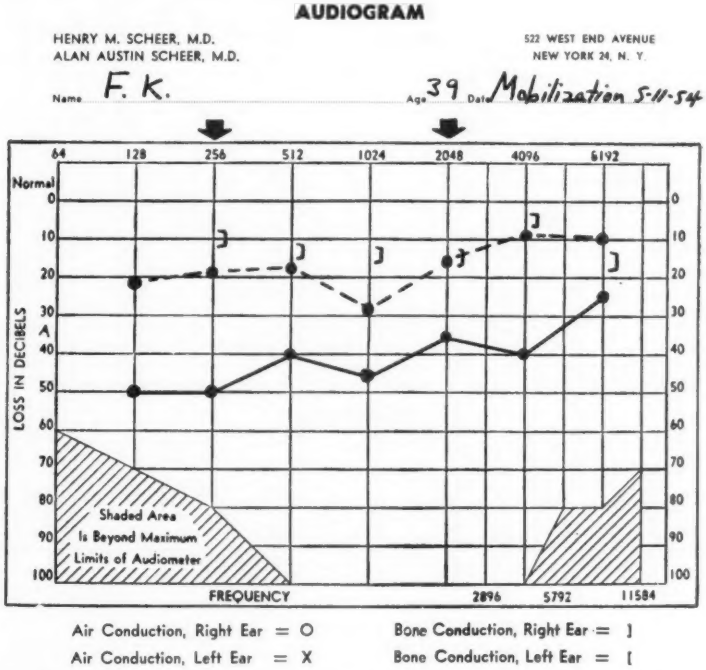

Fig. 10.—The solid line indicates the air conduction of the right ear prior to mobilization of the stapes (same patient as in Figure 9). The dashed line indicates the hearing seven months after the surgery.

ing for the past 12 years. Tinnitus was particularly marked in the right ear. Eustachian tubes were patent. Tympanic membranes were normal. Audiometric studies and tuning-fork tests indicated stapes fixation. On April 1, 1954, the left stapes was found to be fixed and was mobilized, with clinical and audiometric improvement in hearing. On May 11, 1954, the right stapes was exposed and found to be fixed. It was mobilized with moderate pressure. The hearing improvement in each ear has been maintained, as of Dec. 14, 1954. See Figures 9 and 10.

CASE 8.—S. B., a 35-year-old white woman, with a seven-year history of bilateral progressive hearstapes found to be firmly fixed again. It was remobilized, and the hearing came up to the original postoperative level, where it has been maintained in all frequencies, as of Dec. 15, 1954, five and one-half months after the surgery. The chorda tympani nerve had been severed, and taste is still disturbed. See Figure 11.

CASE 9.—S. W., a 46-year-old white woman, with a bilateral hearing loss that began in her late teens. Several members of her family have a hearing loss, including a sister, two brothers, her father, and two uncles. She has had constant tinnitus. There is no history of ear infection. The Rinne test was negative in each ear for the 512

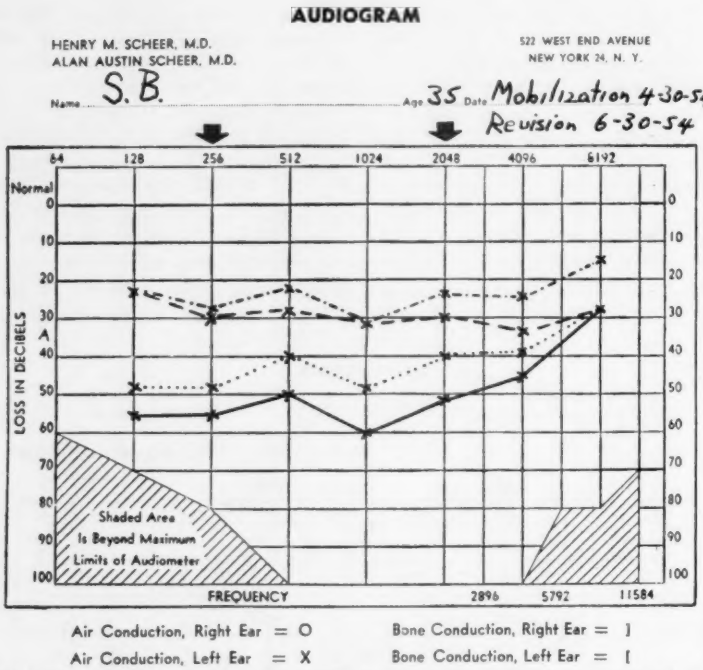
AUDIOGRAM
HENRY M. SCHEER, M.D.
ALAN AUSTIN SCHEER, M.D.
522 WEST END AVENUE
NEW YORK 24, N. Y.
Name S. B.
Age 35 Date Mobilization 4-30-54
Revision 6-30-54
64 128 256 512 1024 2048 4096 8192
Normal
LOSS IN DECIBELS
Shaded Area Is Beyond Maximum Limits of Audiometer
FREQUENCY
2896 5792 11584
Air Conduction, Right Ear = O
Air Conduction, Left Ear = X
Bone Conduction, Right Ear =]
Bone Conduction, Left Ear = [

Fig. 11.—The solid line indicates the air conduction prior to the first mobilization. The dot-dashed line shows the immediate postoperative result. The dotted line shows the level to which the air conduction dropped one month later. The dashed line indicates the air conduction following a revision. This hearing has been maintained five and one-half months.

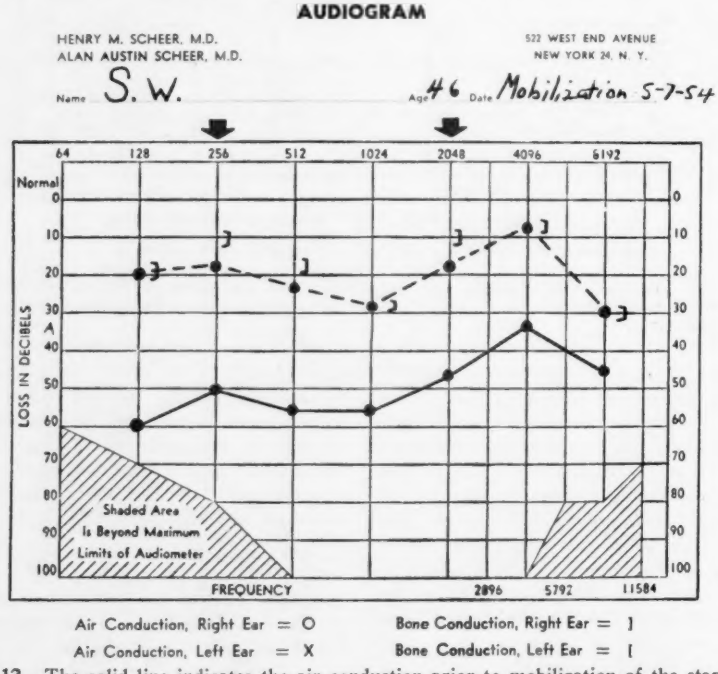
AUDIOGRAM
HENRY M. SCHEER, M.D.
ALAN AUSTIN SCHEER, M.D.
522 WEST END AVENUE
NEW YORK 24, N. Y.
Name S. W.
Age 46 Date Mobilization 5-7-54
64 128 256 512 1024 2048 4096 8192
Normal
LOSS IN DECIBELS
Shaded Area Is Beyond Maximum Limits of Audiometer
FREQUENCY
2896 5792 11584
Air Conduction, Right Ear = O
Air Conduction, Left Ear = X
Bone Conduction, Right Ear =]
Bone Conduction, Left Ear = [

Fig. 12.—The solid line indicates the air conduction prior to mobilization of the stapes. The dashed line shows the air conduction seven and one-half months after the surgery.

and 1024 forks. The right stapes was found fixed on May 7, 1954, and after applying pressure several times, it was mobilized, with a marked improvement in the hearing, which has been maintained in all frequencies. The tinnitus in the ear operated on has stopped. The hearing in the mobilized ear has been maintained in all frequencies, as of Dec. 17, 1954, seven and one-half months after the surgery. See Figure 12.

CASE 10.—H. G., a 30-year-old white woman, had a progressive hearing loss in each ear during the past 10 years. There was no past history of infections or familial hearing loss. Paracusis and occasional tinnitus were noted. Eustachian tubes were patent, and the tympanic membranes were normal in appearance. The left stapes was found firmly fixed on May 7, 1954, and was mobilized after cutting the chorda tympani nerve. The stapes moved suddenly and was then freely mobile. The hearing improvement has been maintained, as of Dec. 17, 1954. There is still a loss of taste on the left side of the tongue. When she wiggles her finger in the left external auditory canal, a tingling sensation is produced on the left anterior part of the tongue. See Figure 13.

CASE 11.—A. M., a 42-year-old white woman, had noted a progressive loss of hearing in both ears for five years. She had been wearing a hearing aid for one year in her right ear. There was no tinnitus, vertigo, or history of previous ear infections. Paracusis was noted. Audiometric studies were characteristic of otosclerosis. The hearing loss in each ear was approximately the same. On May 21, 1954, the left stapes was found fixed. It was mobilized after firm pressure was applied. Immediate hearing improvement was noted, and has been maintained in all frequencies, as of Dec. 13, 1954. See Figure 14.

CASE 12.—B. G., a 38-year-old white woman, has had a bilateral hearing loss during the last six years. There was no history of ear infections or of anyone in the family with a loss of hearing. Tinnitus was moderate in intensity. Tympanic membranes were normal in appearance. On June 15, 1954, the left stapes was mobilized after being found to be fixed. The hearing improvement has been maintained in all frequencies, as of Dec. 14, 1954. See Figure 15.

CASE 13.—R. F., a 48-year-old white woman, has had a bilateral progressive loss of hearing during the last 20 years. Tinnitus was of a mild degree. Paracusis was present. One other member of her family has had a hearing loss. The Rinne test was negative in both ears with the 512 and

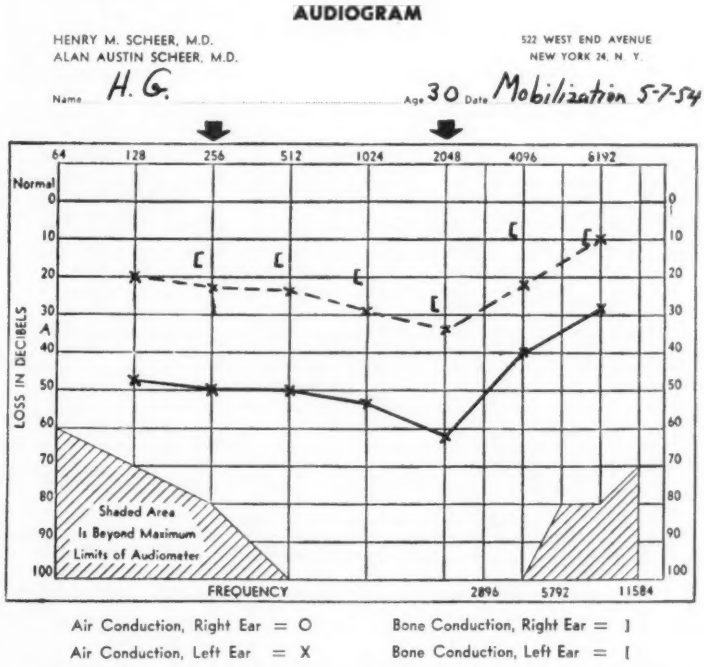

Fig. 13.—The solid line indicates the air conduction prior to mobilization of the stapes. The dashed line shows the air conduction seven and one-half months after the surgery.

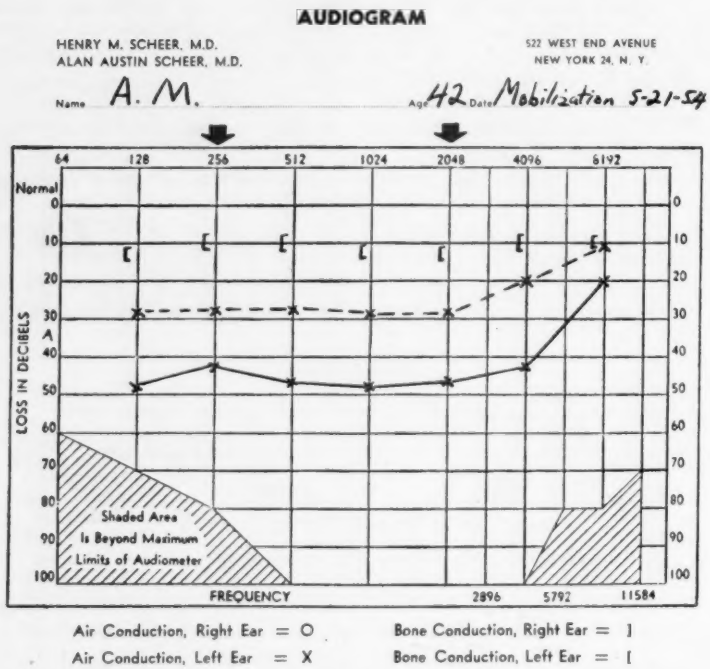
AUDIOGRAM
HENRY M. SCHEER, M.D.
ALAN AUSTIN SCHEER, M.D.
522 WEST END AVENUE
NEW YORK 24, N. Y.
Name A. M. Age 42 Date Mobilization 5-21-54
64 128 256 512 1024 2048 4096 8192
Normal
LOSS IN DECIBELS
Shaded Area
Is Beyond Maximum
Limits of Audiometer
FREQUENCY
2896 5792 11584
Air Conduction, Right Ear = O
Air Conduction, Left Ear = X
Bone Conduction, Right Ear =]
Bone Conduction, Left Ear = [

Fig. 14.—The solid line indicates the air conduction prior to mobilization of the stapes. The dashed line shows the air conduction seven months after the surgery.

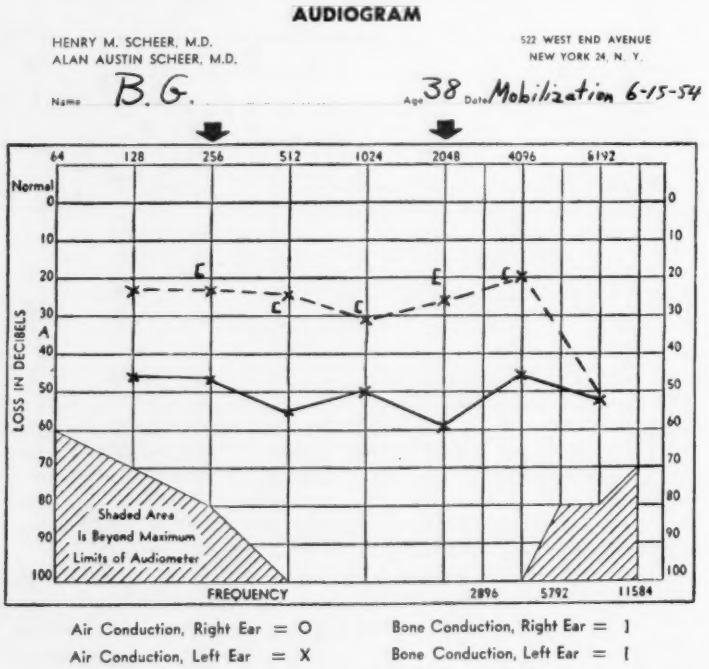
AUDIOGRAM
HENRY M. SCHEER, M.D.
ALAN AUSTIN SCHEER, M.D.
522 WEST END AVENUE
NEW YORK 24, N. Y.
Name B. G. Age 38 Date Mobilization 6-15-54
64 128 256 512 1024 2048 4096 8192
Normal
LOSS IN DECIBELS
Shaded Area
Is Beyond Maximum
Limits of Audiometer
FREQUENCY
2896 5792 11584
Air Conduction, Right Ear = O
Air Conduction, Left Ear = X
Bone Conduction, Right Ear =]
Bone Conduction, Left Ear = [

Fig. 15.—The solid line indicates the air conduction prior to mobilization of the stapes. The dashed line shows the air conduction six months after the surgery.

1024 forks. Audiometric studies showed the typical rising curve seen in otosclerosis. The stapes was exposed on June 28, 1954, and was noted to be firmly fixed. There was definite clinical improvement when the stapes was mobilized. The hearing has been maintained in all frequencies, as of Dec. 8, 1954. See Figure 16.

CASE 14.—R. A., a 38-year-old white woman, with a hearing loss of 10 years' duration. Tinnitus and paracusis were present. The hearing loss in both ears seemed to progress rapidly during her second pregnancy. Ear examination and audiometric studies suggested the presence of stapes fixation. On May 7, 1954, the right stapes was found fixed and was mobilized. There was no improvement in the hearing. On Aug. 2, 1954, the left ear was operated on. The stapes was found to be approximately as fixed as the right one. It was mobilized and became freely mobile. There was a marked clinical and audiometric improvement in the hearing, which has been maintained in the left ear, as of Dec. 20, 1954. See Figure 17.

CASE 15.—L. W., a 54-year-old white man, with a progressive bilateral hearing loss in his left ear beginning 12 years ago. For the last two years he had been using a hearing aid in his left ear. There was no previous ear infection, and both drums had a normal appearance. Paracusis was present. Eustachian tubes were patent. On Aug. 10, 1954, the left stapes was found firmly fixed and was mobilized, with a marked improvement in hearing. During the next two and one-half weeks an infection developed under the skin flap next to the drum and there was a rapid loss of hearing almost to the preoperative level. The infection was controlled and the ear healed, but there was no return of hearing. Two months after the original mobilization a revision was performed. The stapes was found to be as fixed as at the original procedure. The stapes was remobilized, and the hearing improved above that which had resulted from the first operation. This time the ear healed quickly, without any infection, and the hearing has remained at the same level, as of Dec. 20, 1954. See Figure 18.

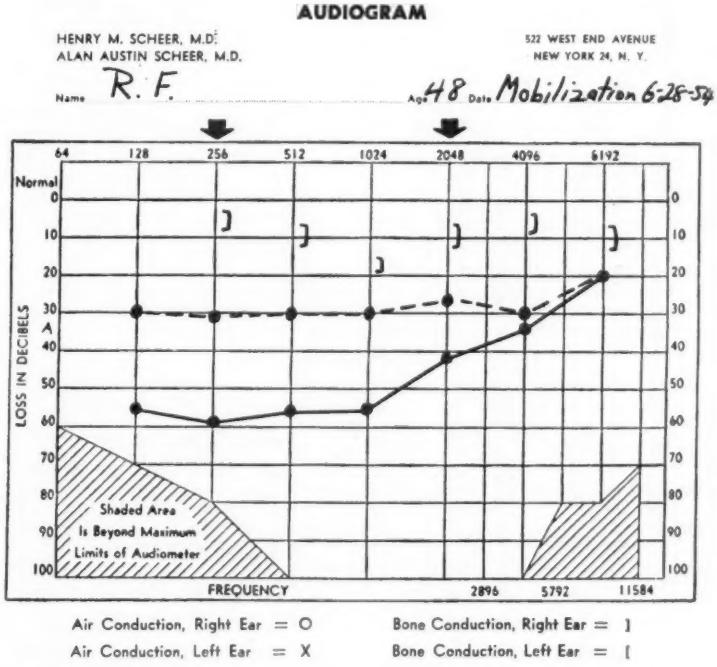

Fig. 16.—The solid line indicates the air conduction prior to mobilization of the stapes. The dashed line indicates the air conduction five and one-half months after the surgery.

CASE 16 (Group B).—E. S., a 36-year-old white woman, hard of hearing for 18 years. She had had a previous fenestration and a revision on her right ear, without success. At this time she has no hearing in the right ear. She had been wearing a hearing aid on her left ear for three years. Her father has been hard of hearing since he was a young man. Audiometric studies indicated rather marked nerve degeneration, in addition to her con-

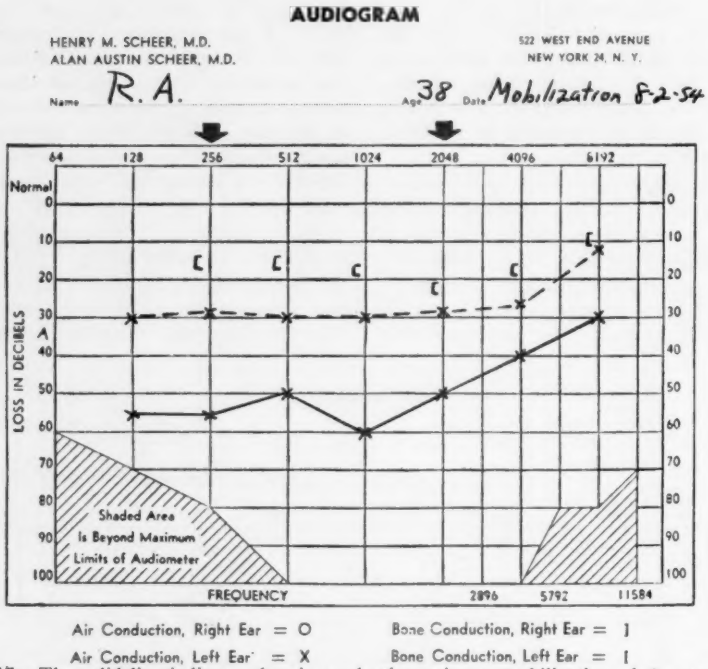
AUDIOGRAM
HENRY M. SCHEER, M.D.
ALAN AUSTIN SCHEER, M.D.
522 WEST END AVENUE
NEW YORK 24, N. Y.
Name R. A. Age 38 Date Mobilization 8-2-54
64 128 256 512 1024 2048 4096 8192
Normal
LOSS IN DECIBELS
FREQUENCY
2896 5792 11584
Shaded Area
Is Beyond Maximum
Limits of Audiometer
Air Conduction, Right Ear = O
Air Conduction, Left Ear = X
Bone Conduction, Right Ear =]
Bone Conduction, Left Ear = [

Fig. 17.—The solid line indicates the air conduction prior to mobilization of the stapes. The dashed line indicates the air conduction five months after the surgery. At a previous operation the opposite stapes was found to be too fixed to successfully mobilize.

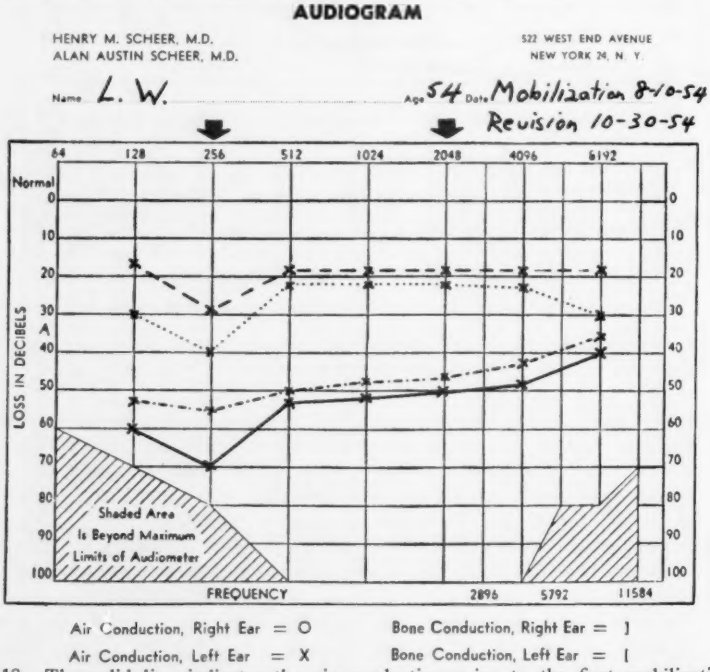
AUDIOGRAM
HENRY M. SCHEER, M.D.
ALAN AUSTIN SCHEER, M.D.
522 WEST END AVENUE
NEW YORK 24, N. Y.
Name L. W. Age 54 Date Mobilization 8-10-54
Revision 10-30-54
64 128 256 512 1024 2048 4096 8192
Normal
LOSS IN DECIBELS
FREQUENCY
2896 5792 11584
Shaded Area
Is Beyond Maximum
Limits of Audiometer
Air Conduction, Right Ear = O
Air Conduction, Left Ear = X
Bone Conduction, Right Ear =]
Bone Conduction, Left Ear = [

Fig. 18.—The solid line indicates the air conduction prior to the first mobilization. The dotted line shows the original improvement after the surgery. The dot-dashed line shows the air conduction two and one-half weeks later. The dashed line is the air conduction that was obtained after a revision. This same level has been maintained two and one-half months.

ductive defect. On April 29, 1954, her stapes was found to be very fixed. The mobilizer was applied to the neck of the stapes over 20 times before it became mobile. There was definite improvement in hearing, but, because of the advanced nerve degeneration, it could not improve to the point where it could be considered adequate according to audiometric criteria. The patient has discarded her hearing aid. This hearing has been maintained, and the patient is very pleased with the result. The most recent audiograms was on Dec. 8, 1954, eight and one-half months after the surgery. See Figure 19.

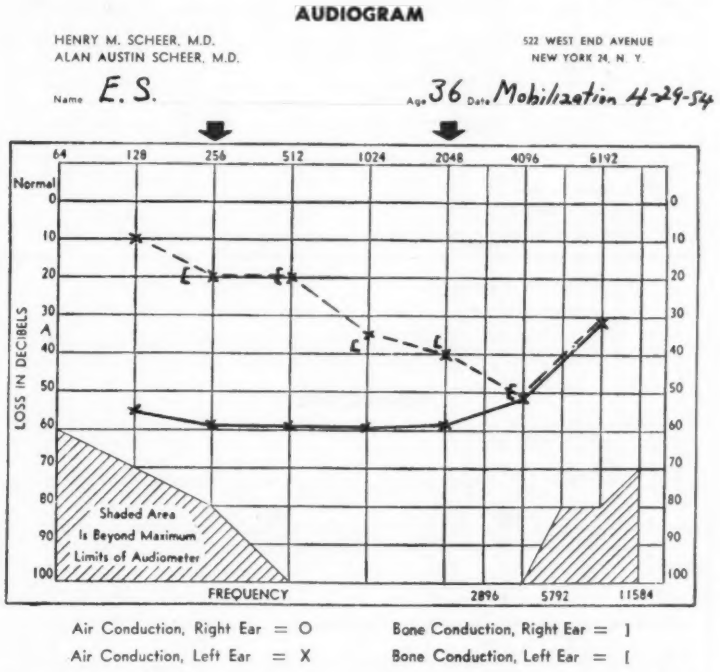

Fig. 19.—The solid line indicates the air conduction prior to mobilization. The dashed line shows the air conduction seven and one-half months following the surgery.

Case 17 (Group B).—S. B., a 52-year-old white woman, noted a bilateral hearing loss for 10 years and had been using a hearing aid on her left ear. On June 2, 1954, the left stapes was exposed and found to be fixed. It was mobilized with moderate pressure. The hearing in the left ear improved above the level of the right ear, which had formerly been the better ear. None of the three middle frequencies are above the 35-db. level, but the patient is very much aware of and pleased with her improvement. As of Nov. 27, 1954, the hearing has been maintained in all frequencies. See Figure 20.

Case 18 (Group B).—B. H., a 44-year-old white woman, has had a gradual bilateral loss of hearing during the last 20 years. A brother and a sister have also been hard of hearing. (The brother, not included in this series, had a mobilization, with a good result.) Tinnitus was constant. She had paracusis. Although there was no history of previous ear infections, the tympanic membranes were thickened and scaly. Audiometric studies and tuning-fork tests suggested otosclerosis. The left stapes was exposed on April 8, 1954, and found to be firmly fixed. The stapes could not be mobilized and fractured. It was removed after the incus was separated from the head of the stapes and the stapedius tendon was cut. Both crura were found to be fractured next to the footplate, which was still in the oval window. On May 21, 1954, the right stapes was exposed. It was firmly fixed, but was mobilized. The hearing improved and has been maintained, as of Dec. 15, 1954, eight months after the surgery. See Figure 21.

Case 19 (Group B).—G. K., a 46-year-old white man, has had a hearing loss for 20 years' duration. Two members of his family lost their hearing at an early age. There was no history of infection or other contributing causes. He had paracusis but no tinnitus. The left ear was operated on May 11, 1954, at which time the stapes was found to be fixed. The hearing improved after mobilization, but during the next three months there was a drop

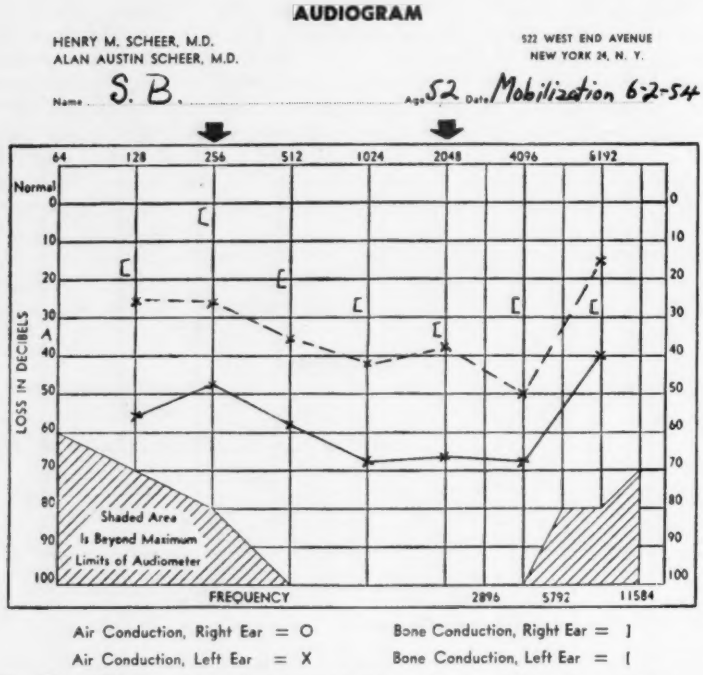
AUDIOGRAM
HENRY M. SCHEER, M.D.
ALAN AUSTIN SCHEER, M.D.
522 WEST END AVENUE
NEW YORK 24, N. Y.
Name S. B. Age 52 Date Mobilization 6-2-54
64 128 256 512 1024 2048 4096 8192
Normal
LOSS IN DECIBELS
Shaded Area
Is Beyond Maximum
Limits of Audiometer
FREQUENCY
2896 5792 11584
Air Conduction, Right Ear = O
Air Conduction, Left Ear = X
Bone Conduction, Right Ear =]
Bone Conduction, Left Ear = [

Fig. 20.—The solid line shows the air conduction prior to mobilization of the stapes. The dashd line is the air conduction six months after the surgery.

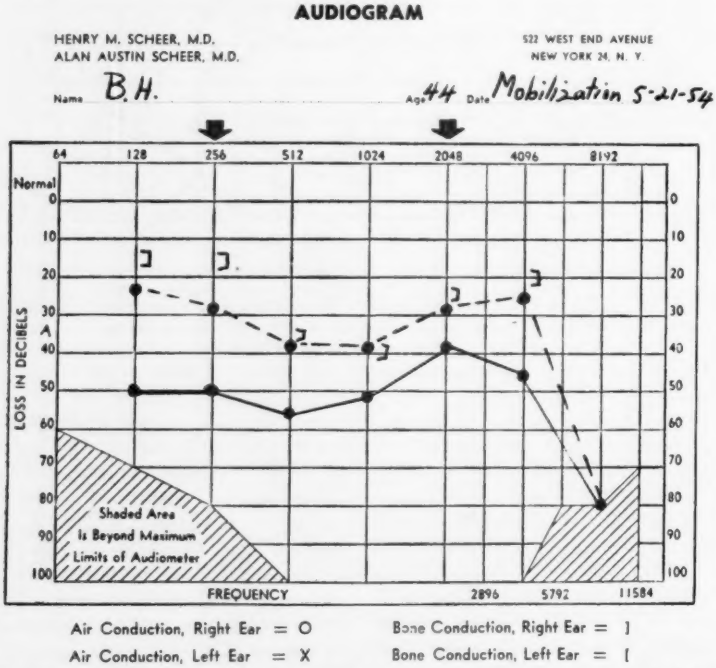
AUDIOGRAM
HENRY M. SCHEER, M.D.
ALAN AUSTIN SCHEER, M.D.
522 WEST END AVENUE
NEW YORK 24, N. Y.
Name B. H. Age 44 Date Mobilization 5-21-54
64 128 256 512 1024 2048 4096 8192
Normal
LOSS IN DECIBELS
Shaded Area
Is Beyond Maximum
Limits of Audiometer
FREQUENCY
2896 5792 11584
Air Conduction, Right Ear = O
Air Conduction, Left Ear = X
Bone Conduction, Right Ear =]
Bone Conduction, Left Ear = [

Fig. 21.—The solid line is the air conduction prior to mobilization. The dashed line is the air conduction seven months after the surgery. At a previous operation the opposite stapes was found to be too fixed to successfully mobilize.

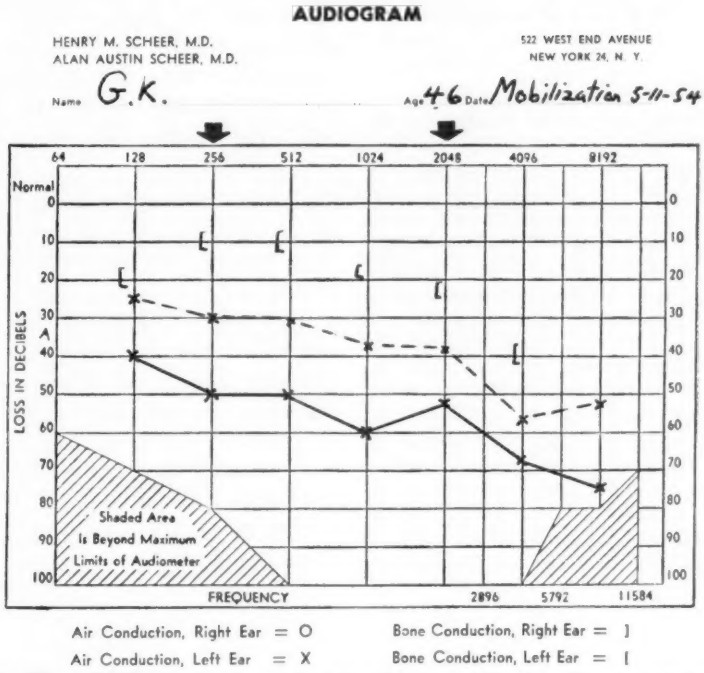

Fig. 22.—The solid line is the air conduction prior to mobilization. The dashed line is the air conduction seven and one-half months after the surgery.

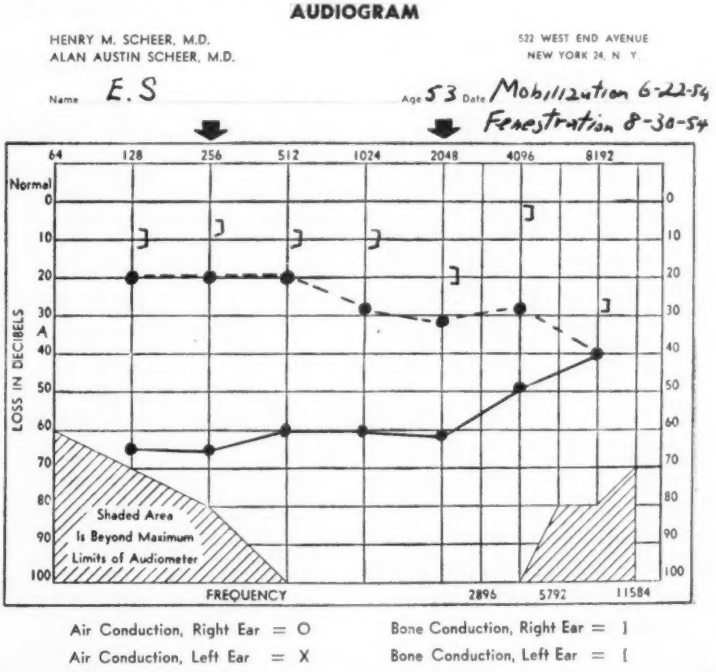

Fig. 23.—The mobilization operation was unsuccessful in each ear. The stapes were fractured. This audiogram indicates that a successful fenestration can result after a previous mobilization has failed. The solid line is the air conduction following an unsuccessful mobilization. The dashed line is the air conduction two and one-half months after fenestration.

of 10 db. in the 1024 and 2048 frequencies. There has been no further loss, as of Dec. 17, 1954. See Figure 22.

CASE 20.—E. S., a 53-year-old white woman, has had a bilateral hearing loss beginning in her early 20's. Her mother and brother are quite deaf, and her daughter has an early hearing loss. She had worn a hearing aid for eight years in her left ear, but could never reconcile herself to her situation. There was moderate tinnitus in each ear and definite paracusis. No history of aural infections. On June 14, 1954, mobilization of the left stapes was attempted, but failed when the stapes fractured. When the ear healed there was no audiometric improvement in the hearing, but the patient stated that she heard better on the phone. An attempt was made to mobilize the right ear on June 22, 1954, but again the stapes was found to be too fixed and there was an audible click, followed by a too freely moveable stapes, indicating that the crura had fractured. On Aug. 30, 1954, a fenestration was performed on the right ear, nine weeks after the unsuccessful mobilization. There were no unusual difficulties encountered. During the fenestration the crura of the stapes were noted to be fractured. The ear has healed nicely, and there has been a very satisfactory improvement in hearing. See Figure 23.

SUMMARY AND CONCLUSIONS

A preliminary report reviewing the results of 50 cases of clinical otosclerosis treated surgically by transtympanic mobilization of the stapes is presented. These patients have been followed from 6 to 10 months.

The fact that this transtympanic technique can restore hearing to patients with otosclerosis is established: Forty-seven (94%) of the stapes were found to be fixed at the time of surgery; 31 (62%) of the stapes were mobilized, but only 15 (30%) got a Group A result, where the return of hearing was to a serviceable level (30 db. or better); 16 (32%) of the stapes were fractured, because they were too fixed.

The histories and audiometric studies of all Group A cases and those where there was some hearing improvement in Group B are presented.

Two stapes (Group A results) became refixed in the oval window after mobilization but were remobilized, with a return of hearing to the original postoperative level. There is some evidence to suggest that postoperative infection is a factor that hastens the refixing of a mobile stapes.

It is shown that a fenestration can be successfully performed after an unsuccessful mobilization.

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Malignant Tumors of the Temporal Bone

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During the past three years we have encountered a series of primary and secondary neoplasms of the temporal bone among the population of about a million people in the vicinity of our hospitals. The series includes metastatic tumors and one verified locally malignant growth of the type formerly regarded as bleeding polypus and sometimes reported as angioma, but now realized to be a glomus tumor.

In the light of our experience and studies, we classify malignant tumors of the temporal bone as follows:

I. Primary: Tumors of the middle ear and mastoid include squamous cell and basal cell carcinomas and adenocarcinoma. Glomus tumors also fall into this category. Tumors of the petrous pyramid include meningioma, sarcoma, melanoma, neuroepithelioma, and acoustic neurofibroma.

II. Secondary: A. Invasive: This group includes carcinoma or lymphoepithelioma of the nasopharynx, tumors of the parotid gland, tumors of the cerebellopontine angle, basal cell carcinoma and melanoma of the auricle, which may penetrate the temporal bone from these various adjacent regions.

B. Metastatic: Cases of metastasis from hypernephroma and adrenomedulloblastoma will be mentioned.

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During the past three years six cases of squamous carcinoma have been seen by us (Table). An arbitrary classification into intrinsic and extrinsic types has been suggested by various writers, such as Figi and Hempstead,[12] depending upon whether the growth arose medial or lateral to the isthmus of the external auditory meatus; the same observers[11] reported that in six of eleven cases deemed to have been caused by otorrhea, the cancer had originated in the external canal. In our cases it was not always possible to identify the site of origin, but in Case 5 it appeared to start in the depths of the meatus.

Brunner,[2] describing a case of basal cell carcinoma of the ear, agreed with the discrimination between extrinsic and intrinsic types, and reported the presence of aberrant parotid tissue in the adventitia of the jugular bulb, analogous to the glomus tissue described by Guild.[17] This tissue is subjacent to the middle ear and when it becomes adenocarcinomatous, erodes its floor.

Of our six cases, two were in males and four in females, with ages ranging from 36 to 65. In the series of Figi and Hempstead * males and females were affected in equal proportions and the age incidence ranged from 27 to 80 years, the majority of patients being between 40 and 70. Furstenberg[14] made an extensive study of the literature and found 75 authentic cases. He estimated the incidence at 1 in 20,000 of all aural conditions. Mattick and Mattick,[32] working in a large cancer clinic, found only ten cases of intrinsic aural carcinoma among 30,000 tumors of all kinds. At the Mayo Clinic, over a six year period, the incidence was 0.003%. Our figure of half a dozen cases at any one time in a population of a million persons probably represents the true

* References 11 and 12.

Authors' Cases of Squamous Carcinoma

Case	Age	Sex	History	Symptoms	Type of Growth	Treatment	Result
1	65	F	55 years left otorrhea	Radical mastoid Aug. 1952; 9 months later pain & discharge recurred; granulations; profuse bleeding on touch	Well differentiated squamous cell carcinoma	Radiotherapy	Under observation
2	63	F	10 years left otorrhea	Papillomatous mass in meatus; at operation growth filling middle of ear	Squamous epithelium	Radical surgery not practical radiotherapy	Under observation
3	38	M	30 years previously rt. radical mastoidectomy	6 mo. pain in rt. ear; postauricular swelling; glands in neck	Biopsy of gland, squamous cell carcinoma	Reopening of mastoid, biopsy of granulation tissue negative	Patient died
4	63	F	Left middle ear infection 12 years	External otitis, left ear, one year; appearance rolled edge in posterior border of external meatus	Well differentiated squamous cell carcinoma	Radiotherapy	Under observation
5	43	F	Left otorrhea for over 30 years	Foul discharge left ear of more recent onset; granulations bleeding easily on touch	Squamous-cell carcinoma, thought to arise in skin depths of meatus	Postauricular incision, radical mastoidectomy with removal of external auditory meatus and diathermy; deep x-ray postop.	Good recovery; no sign of recurrence 1 year after operation
6	40	M	Rt. otorrhea over 30 yr., polypi removed 4 times	Radical mastoidectomy May, 1953; 9 mo. later pain, recurrence of discharge & bleeding from meatus; later facial paralysis and vertigo	Squamous-cell carcinoma; well-differentiated type of growth	Reopening cavity; diathermy coagulation; complete removal impossible; palliative x-ray therapy	Nine months later going downhill rapidly; extensive hemorrhage from growth; tumor involving occipital region

incidence of aural carcinoma. Any apparent increase in recent years is probably due to earlier diagnosis and prompt biopsy.

We consider that aural carcinoma has much in common with Marjolin's ulcer. J. N. Marjolin [31] (not his son René, as sometimes stated) first demonstrated the development of malignant ulceration in cutaneous scars and chronic ulcers, sanious discharges producing intracellular irritation in the manner described by Glover [15]; periods of healing by thin unstable epidermis, alternating with phases of cicatricial contraction, subjected the cells to stress. Ineffective surgery may inflict further trauma. In our Case 6 otitis media had pursued an indolent course for nearly half a century, recurrent polypi having been removed from time to time, before the final development of well-differentiated squamous cell carcinoma. Indeed, chronic otorrhea preceded malignancy in all our cases; in four it was of more than 30 years' duration; it therefore appeared to be the main factor in our admittedly small series, although we recognize that no tissues are immune from apparently spontaneous carcinoma.

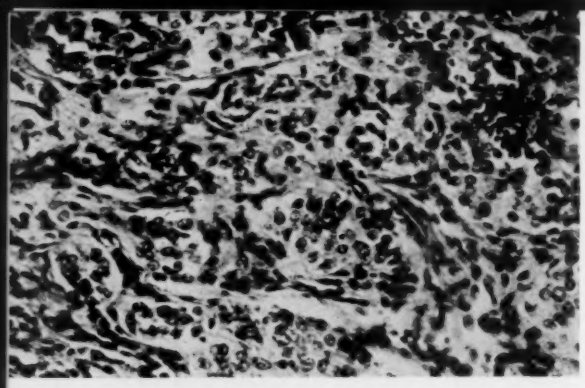
Severe pain was a constant feature in all patients, and in Case 3 caused the suspicion of cerebral abscess. Fetid hemorrhagic discharge was, however, the chief symptom, especially when it developed in radical operation cavities, as in two of our cases. Polypi which bled easily at a touch proved equally ominous. Deafness, though constant, was never the presenting symptom. According to Wall and Gromet,[48] sudden unilateral deafness in the absence of an epidemic of mumps should always arouse suspicion of malignancy. Tinnitus and vertigo developed later in one case. Facial paresis was a very constant late symptom. If the growth originated on the promontary, it appeared early. Facial paresis is also an early symptom of neurinoma of the facial nerve. Trigeminal neuralgia, corneal anesthesia, and paresis of the ninth to twelfth cranial nerves occurred in one case.

Differential diagnosis, especially from cholesteatoma, can be achieved only by biopsy, or by the recognition of cancer cells in discharges by the technic of Papanicolaou,[35] as advocated in aural cases by House. Dingley [9] described a case of granuloma, later found to be one of Hand-Schüller-Christian [41] disease, an affection which may respond to irradiation, or to cortisone. Radiographic appearances were rarely diagnostic in the early stages, but subsequently revealed the ravages of the disease. Arrested pneumatization, cholesteatosis, and operations such as radical mastoidectomy rendered the interpretation of mastoid radiograms more difficult. Nevertheless, radiologic studies were invaluable. To exclude multiple myelomatosis or metastasis, the whole skull and certain other bones were sometimes x-rayed. Skiagrams in Case 6 demonstrated erosions extending into the occipital region which were less circumscribed than cholesteatomous cavities in dense petromastoid bone.

Histologically, squamous cell carcinoma of well-differentiated type, corresponding to Types I and II of the classification of Broders,[1] was eventually demonstrated in all cases. Earlier biopsy specimens in Case 3 were negative, both from the mastoid and from the cervical glands.

Treatment consisted of radical excision and postoperative irradiation. In Case 5, radical mastoidectomy was augmented by sleeve resection of the external auditory meatus with the diathermy cutting current, as advocated by Grossman, Donnelly, and Snitman.[16] That there is no recurrence after twelve months encourages hope of survival. Postoperative or primary irradiation has been carried out by our colleagues at Bradford, to whom we are most grateful. The technicalities of irradiation were dealt with exhaustively by Thorell [45] in 1935. An interesting innovation was treatment by Co^{60}, as described by Means and Gersten.[33]

The prognosis is grave because mastoid carcinoma is so insidious in onset and consequently advanced at discovery or, at least, at histologic confirmation. A few survivals of five years and upward have been reported. Termination within three years by hemorrhage or cachexia is the general rule. Thor-



Case of Mrs. Ivy P., glomus tumor of the right ear (× 450); reduced approximately one-half. The photomicrograph shows the alveolar arrangement of clusters of cells, abundant cytoplasm of indefinite outline, and round or oval nuclei exhibiting no mitoses. The trabeculae of fibrous tissue which separate the cells into bundles are traversed by thin-walled blood vessels.

ell [45] reported two out of nine cases free from symptoms seven and nine years respectively after the commencement of treatment. Mattick and Mattick [32] reported two out of seven patients who remained free of recurrence for over five years. One of our cases bids fair to add itself to the small company of survivors. The distinction between curative and palliative treatment must be recognized.

Let us now pass to consideration of satellite tumors of the glomus jugulare. The following is an illustrative case:

Mrs. I. P., aged 55, complained on June 3, 1953, of recent deafness of the right ear; the left ear had been deaf for 30 years. Examination revealed acute catarrhal otitis media on the right side, which responded to antibiotics. The left tympanic membrane was also red and swollen. Myringotomy was performed and gave rise to hemorrhage, which persisted for 48 hours. In December, 1953, biopsy of a polypoid swelling in the floor of the middle ear and external auditory meatus revealed the presence of a glomus tumor. In March, 1954, radical mastoidectomy was carried out; hemorrhage was controlled by methods which included lowering of the blood pressure by the anesthetist. The tumor was removed and the hypotympanum was curetted. Convalescence was uneventful and was followed by irradiation.

It is interesting to recall the anatomy and physiology of the tissues from which these glomus tumors grow. It is believed that the main nonchromaffin glomus bodies situated at the bifurcation of the carotid arteries are chemoreceptors. They are thought to send impulses generated by the CO_2 and O_2 of the blood and by its pH via the intercarotid nerve and glossopharyngeal nerve to the medulla. As tissues of the branchial arches, it is not surprising that they should have satellites in the tubotympanic recess, as shown by Guild in 1941, who maintained in a later paper that the bodies described by Valentin [47] in 1840 really were neural ganglia, as stated by him, and not glomera, as currently supposed. Minute bodies 0.5 mm. in diameter are situated in the adventitia of the dome of the jugular bulb, along the tympanic branch of the glossopharyngeal and along the tympanic branch of the vagus nerves. The capillaries of trabeculae which separate clusters of epithelioid cells are supplied with blood by the ascending pharyngeal artery.

Early cases of glomus tumor were described by Lubbers [26] and by Rosenwasser [40]; 58 had been recorded up to 1952. The ages of those affected ranged from 5 to 78 years; 82% of the patients were females.

The first symptoms are deafness, tinnitus, and pain. These are present for some time before blueness and bulging of the tympanic membrane supervene, or the tumor can be detected by compression of the column of air in the meatus with the aid of a Siegle speculum. Gradually, perforation of the drum and protrusion of an angioid mass lead to recurrent hemorrhage, but growth is so slow that it may be many years before the labyrinth is invaded. A treacherous trait is that biopsy of superficial fragments merely reveals connective tissue covered by stratified epithelium, the glomus tissue being situated more deeply. Termination is by invasion of the cranial nerves within the jugular foramen and finally by hemorrhage or infiltration of the brain. Radical excision is, when feasible, the treatment of choice. These tumors were formerly thought to be radioresistant, but Capps [3] observed one good response to irradiation in a recurrent case.

Primary tumors of the petrous pyramid have not been detected in our own clinics during the period under review, although we have seen a few recently at otological meetings at home and abroad, and a number in previous years.

Meningiomas, according to Cushing and Eisenhardt,[8] arise from the arachnoid granulations which lie along the course of the dural venous sinuses, especially along the superior sagittal, but also along the superior and inferior petrosal sinuses. The vicinity of the trigeminal ganglion and internal auditory meatus are additional potential sites. Such tumors may invade the petrous temporal, though the bony labyrinth itself, being of endochondral origin, is relatively resistent. Proctor and Lindsay [37] described the case of a woman aged 55 who developed severe pain and otorrhea accompanied by paralysis of the 7th, 11th, and 12th cranial nerves on the right side, and eventually died from septic complications. Histology revealed a meningioma with an alveolar arrangement of cells, assumed to originate in the arachnoid granulations in the vicinity of the jugular foramen.

Sarcoma is another rare tumor of the temporal bone. Our impression is that osteosarcoma of the cranial bones was more common twenty-five years ago, when cases such as one illustrated by Phillips [36] were encountered, especially among children and adolescents, the spindle-cell and round-cell forms being the most frequent. Kincade [21] reported an angiosarcoma of the petrous temporal, the cellular nuclei of which contained many mitoses, but concluded that "it must remain questionable whether this tumor arose from some portion of the arachnoid within the petrous bone or from some structure native to the bone itself."

Malignant melanoma originating in the middle ear induced a peculiar dark blue discoloration of an intact tympanic membrane in a case reported by Cordes and Masing.[7] The diagnosis was obscured because of previously existing trauma. In a case recorded by Friedmann and Radcliffe [13] death occurred three years after the institution of therapy.

Neuroepithelioma of the petrous bone was observed in a woman aged 49 by Tuta.[46] She developed paralysis of the 5th to the 12th canial nerves on the right side and died sixteen months after the onset of neuralgia, which was the first symptom. At autopsy the tumor was found to originate in the petrous temporal but to have invaded the pons. Histology revealed a neuroectodermal tumor, cells resembling primitive spongioblasts being arranged around small canals in rosettes. The conclusions of Tuta are borne out by Wohlwill,[49] who described an asthesioneuroepithelioma derived from the olfactory placode.

Intratemporal dermoids have arisen from embryonic cell nests. The case of primary papilliferous cystoma reported by Jefferson and Whitehead [20] was one in which hypernephroma and a cystic pancreas were also present.

Acoustic neurofibroma, though innocent, may become sarcomatous or, if pigmented, melanomatous. Unilateral deafness of gradual onset calls for radiography of the internal auditory meati to exclude acoustic neuroma, to which the vestibular and facial nerves are also vulnerable. An early symptom is corneal anesthesia. Persons with von Recklinghausen's disease may develop neurofibroma of the acoustic nerve. A case of bilateral neurofibromatis is included in a contribution by Proctor and Lindsay.[37] It is to Lüscher [28] that we are indebted for the observation that early facial paresis is suggestive of neurinoma of the facial nerve.

Tumors of the nasopharynx and base of the skull commonly invade the temporal bone by contiguous spread. Druss [10] described a case of infiltration of the petrous temporal by a carcinoma originating in the adjacent basisphenoid of a man aged 65. Colledge [6] described a case of invasion from another source, namely, the parotid; the tumor in question, which projected into the nasopharynx, proved on histologic examination to be a spindle-cell sarcoma. Proctor and Lindsay [37] gave an instance of yet another mode of attack upon the petrous pyramid and internal auditory meatus, namely, by a glioma of the pons.

Metastatic tumors from distant primary sites arise when the marrow of the temporal bone filters out circulating cancer cells. This happens only rarely, because in the age

group most vulnerable to malignant disease, the red marrow is progressively being replaced by fatty tissue. The following is an illustrative case which came before one of us:

A man aged 47 complained of unilateral deafness. Facial paresis on the same side and dysphagia developed. Severe headaches ensued. After abortive surgical exploration the patient died. At postmortem examination a primary renal tumor—a hypernephroma—and secondary deposits in the temporal bone and brain were found.

In childhood, the syndrome of Hutchison [19] is all too common. Lodge and Brookes [25] described such a case, in which the temporal bone was among the tissues affected. Other cases have been described of secondary deposits from carcinoma of the mammary gland and prostate. Clearly, the possibility of a remote primary tumor must always be excluded, by examination of such organs as the breast, bronchi, kidneys, prostate, and thyroid, tumors of which have a predilection for metastases in bone. The prognosis is not absolutely hopeless in every case. One of us removed a secondary hypernephroma from the brain 25 years after a colleague had performed nephrectomy, and the patient had no further metastases. Professor M. J. Stewart tells of similar instances of one metastasis and no more, in cases of this type.

SUMMARY

Six cases of carcinoma of the middle ear and mastoid, a glomus-jugulare tumor, and a secondary metastasis in the temporal bone are described. Tumors of the temporal bone have been classified as primary, invasive, and metastatic, and the literature is reviewed.

Our cases were collected from a population of about a million in a period of three years, which roughly corresponds to the life history of most cases of malignant disease; thus, 0.006 per thousand living persons are suffering from aural carcinoma. Hopes of recovery are entertained in one case of carcinoma, and it is hoped that earlier diagnosis may lead to a greater proportion of five-year cures. Suspicion was usually aroused by progressive unilateral deafness, severe persistent pain, aural discharge becoming hemorrhagic and fetid, and, finally, by facial paralysis; all dubious polypi were studied histologically.

The recognition of tumors of tympanic satellites of the glomus jugulare constitutes a recent advance in otology; their clinical behavior goes to prove that malignancy is a matter of degree.

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Hypopharyngeal Bar

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There is no definite anatomical borderline between hypopharynx and cervical esophagus. In 1949 Testut and Latarjet [1] claimed that it was generally agreed upon to place the borderline at a horizontal plane which touches the inferior margin of the cricoid cartilage and crosses the body of the sixth cervical vertebra. This borderline is arbitrary and, in addition, is not accepted by all anatomists and clinicians.

Since the classical description of Luschka [2] the inferior constrictor muscle of the pharynx is divided into (1) an oblique portion which makes its insertion mainly on the thyroid cartilage, and (2) a transverse portion which is attached to the cricoid cartilage (M. cricopharyngeus). Killian [3] claims that the cricopharyngeal muscle consists of both oblique and transverse fibers (Fig. 1).

Of importance are two areas in the posterior wall of the hypopharynx and the cervical esophagus, respectively, because in these areas the wall is weak and may yield to pressure from within. One area is situated between the transverse and oblique portions of the cricopharyngeal muscle and may be called "membrana hypopharyngis." The other area is situated between the transverse portion of the cricopharyngeal muscle and the circular fibers of the cervical esophagus and may be called "membrana oesophagi." The latter is also called "Laimer's triangle," because it was discovered by Laimer.[4] It

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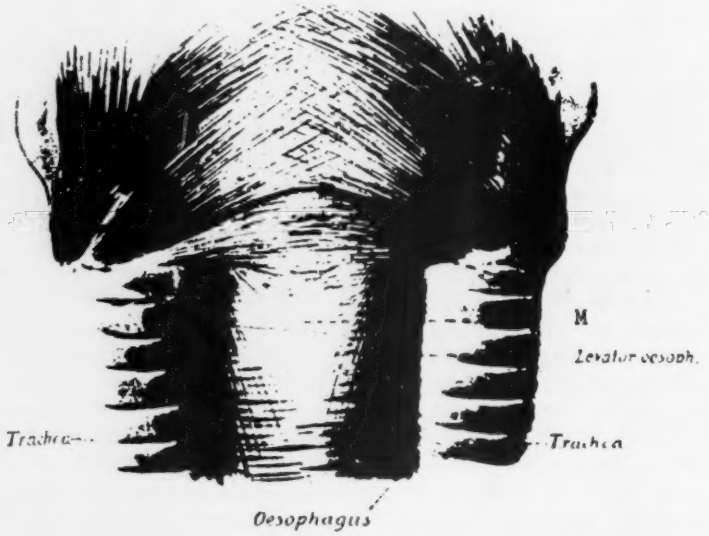


Fig. 1.—Inferior constrictor muscle seen from back. The trachea is split and bent backwards. Note that the constrictor inferior muscle consists of an oblique and a transverse portion. Between the two portions there is a slit, the base of which consists of the membrana hypopharyngis. Between the transverse portion of the inferior constrictor muscle and the uppermost circular fibers of the esophagus there is the membrana oesophagi (*M*), or Laimer's space. (From Killian, G.: Ztschr. Ohrenh. **55**:1, 1908.)

forms a triangle, the tip of which is directed toward the esophagus. It extends from the inferior margin of the cricoid plate downward and contains only a few transverse muscle fibers but no longitudinal muscle fibers (Fig. 1). The Zenker diverticulum usually originates in the area of the membrana hypopharyngis.

Since in the anatomical specimen the circular fibers of the cricopharyngeal muscle cannot be exactly distinguished from the uppermost circular fibers of the cervical esophagus a definite borderline between hypopharynx and cervical esophagus cannot be determined. However, there is a physiological borderline between the two organs because the transverse fibers of the cricopharyngeal muscle act as a sphincter, which was called by Killian [3] "the mouth of the esophagus." It is a moot question as to whether the sphincter muscle of the hypopharynx consists of the circular fibers of the cricopharyngeal muscle or of the uppermost circular fibers of the esophagus or both. Holmgren [5] believes that it probably consists of both, cricopharyngeal and esophageal fibers. It seems that from the clinical point of view this question is of minor importance.

If the sphincter muscle undergoes an active contraction it forms the "hypopharyngeal bar"[6] analogous to Passavant's bar in the epipharynx. The hypopharyngeal bar (Fig. 4) presents the borderline between hypopharynx and cervical esophagus. Above the bar is the hypopharynx, below the cervical esophagus. The contraction of the sphincter muscle, i. e., the hypopharyngeal bar, can be easily elicited if the patient performs Valsalva's experiment.

The hypopharyngeal sphincter has a different appearance (1) in the state of inactivity, (2) in the state of normal deglutition, and (3) in the state of defense. In the state of inactivity there is a tonic contraction of the muscle which results in an approach of the posterior wall of the hypopharynx to the cricoid plate (Fig. 2). During normal deglutition the sphincter muscle relaxes in order to allow the bolus to pass into the esophagus. It is only exceptionally possible to grasp this

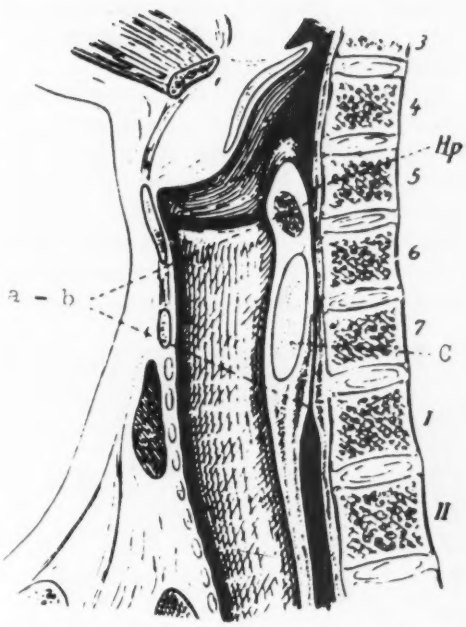


Fig. 2.—Sagittal section through the hypopharynx (*Hp*) and the cricoid plate (*C*). Between *a* and *b* the hypopharynx is closed in the state of inactivity. (From von Luschka, H.: Der Schlundkopf des Menschen, H. Laupp, 1868.)

phase of the activity of the sphincter muscle by means of cinematographic x-ray examination.

In the past the relaxation of the sphincter muscle has been considered to be the result of the dislocation of the larynx during deglutition. This is not correct. In agreement with Killian [3] it was proved by Waldapfel [7] that it is possible to dilate the hypopharynx by pulling the larynx forward. However, at the same time the sphincter muscle undergoes an active contraction, forming a hypopharyngeal bar, and shuts off the entrance into the esophagus. In other words, dislocation of the larynx forward and upward causes a dilatation of the hypopharynx and simultaneously an active contraction of the sphincter muscle of the hypopharynx (Figs. 3 and 3*a*). This proves that the relaxation of the sphincter muscle during deglutition is not the result of the dislocation of the larynx; it is rather due to a specific nervous mechanism. Sjöberg [8] claims that the relaxation of the sphincter muscle is controlled by the

vagus nerve, the contraction by the sympathetic nerve—similar to the finding at the cardia.

It is a moot question as to whether the relaxation of the sphincter muscle results in an active dilatation of the hypopharynx or implies simply a decrease of the muscle tone without active dilatation of the lumen. I favor the latter view. This is based on the fact that there are cases which show a spontaneous hypopharyngeal bar (Fig. 6), viz., a permanent spastic contracture of the sphincter muscle and thus a permanent narrowing of the lumen of the sphincter. Yet a great number of these patients do not complain of troubles in swallowing. It is more likely that in these cases the relaxation of the sphincter muscle is due rather to a diminution of the muscle tone than to an active dilatation of the sphincter. It is a fair conclusion that in normal persons the relaxation of the sphincter is likewise due rather to a diminution of the muscle tone than to an active dilatation of the sphincter.

Fig. 3.—There is a lateral exposure of a normal larynx and pharynx. (*c*) indicates calcium deposits in the cricoid plate. Note that the hypopharynx cannot be differentiated.

Contrary to the relaxation of the sphincter muscle during normal deglutition, the muscle undergoes a contraction when material approaches the sphincter which may damage the digestive tract, as foreign bodies, pus, tumor tissue, or air. The result of the contraction is the hypopharyngeal bar. In this respect the function of the hypopharyngeal bar is the same as the function of Passavant's bar: the latter prevents the entrance of inappropriate material into the epipharynx, the former the entrance of inappropriate material into the esophagus.

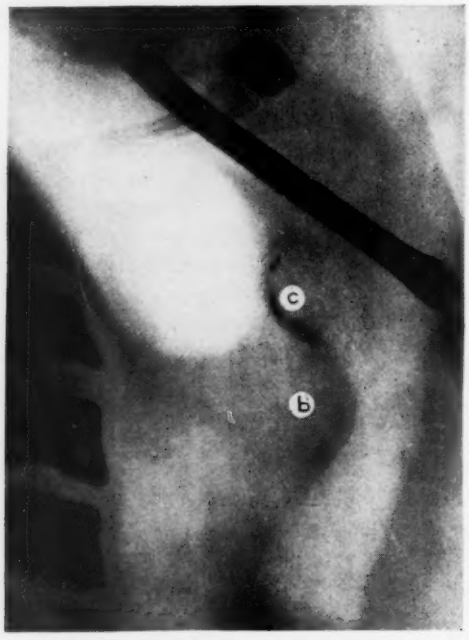


Fig. 3*a*.—An Eicken hook is introduced into the larynx and the larynx is pulled forward and upward. The result of the dislocation of the larynx is an opening of the hypopharynx and the formation of a hypopharyngeal bar (*b*). (From Waldapfel, R.: Fortschr. Geb. Röntgenstrahlen, Ergänzungsband 57, 1938.)

The hypopharyngeal bar can be conveniently examined during Valsalva's experiment, viz., during inflation of air into the hypopharynx. The result of this examination may be (*a*) a moderate contraction or (*b*) an excessive contraction of the sphincter muscle or (*c*) a failure of the muscle to contract (Fig. 4). If there is a moderate contraction, the hypopharyngeal bar forms

a moderate but distinct elevation which gradually passes into the walls of the cervical esophagus. The alimentary channel within the bar likewise forms a distinct curve, which gradually passes into the lumen of the cervical esophagus. This is Type I of the hypopharyngeal bar (Fig. 4, *II*).

If the contraction is excessive, the hypopharyngeal bar bulges markedly toward the trachea and the inferior surface of the bar forms an angle of approximately 90 degrees with the wall of the cervical esophagus. The alimentary channel within the bar is markedly bulged and narrow. It communicates with the dilated hypopharynx at the floor of the latter. This is Type II of the hypopharyngeal bar (Fig. 4, *III, IV, V*). There is no distinct boundary between the two types. Not infrequently the contracted sphincter muscle bulges not only toward the trachea but also upward toward the dilated hypopharynx. In these instances the alimentary channel does not originate at the floor of the hypopharynx but on the anterior wall while the rest of the hypopharynx forms a pouch at the area of the membrana hypopharyngis, which extends into the space between the muscle and the vertebra. Inasmuch as this pouch is quite a common finding we call it "diverticulum spurium hypopharyngis" (Fig. 4, *V;* Fig. 5, 5*a*).

From its junction at the hypopharynx the alimentary canal runs around the convexity of the contracted sphincter muscle toward the inferior surface of the hypopharyngeal bar, but it does not empty straight ahead into the cervical esophagus; it runs rather along the inferior surface of the bar toward the membrana oesophagi. Here the alimentary channel again may form a small pouch—the "diverticulum spurium oesophagi" (Fig. 4, *IV, V*; Fig. 5, 5*a*), which is more frequent than the diverticulum spurium hypopharyngis. Contrary to the diverticulum spurium hypopharyngis (and Zenker's diverticulum), which is situated above the sphincter muscle, the diverticulum spurium oesophagi appears below the muscle. It extends in an upward direction toward the hypopharynx, which is likewise contrary to both the diverticulum spurium hypopharyngis and the Zenker diverticulum, which extend in a downward extension toward the thorax.

In the area of the membrana oesophagi the alimentary channel within the hypopharyngeal bar passes into the cervical esophagus, forming a sharp angle.

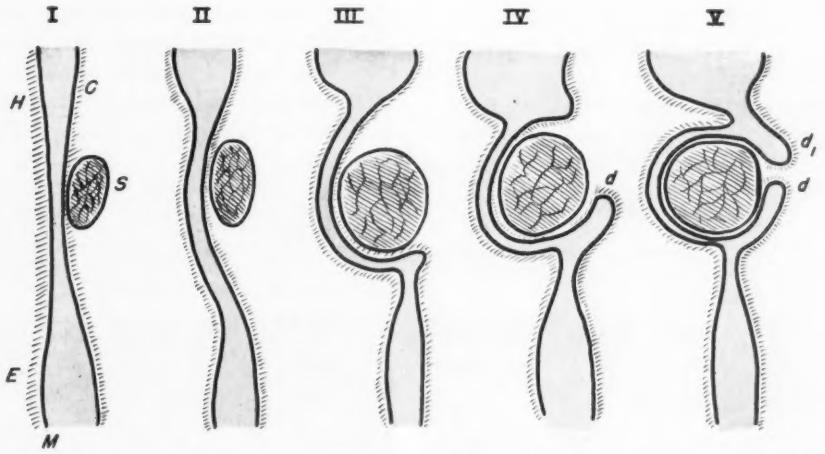


Fig. 4.—Types of hypopharyngeal bar. *H*, hypopharynx; *C*, connective tissue; *S*, sphincter muscle; *E*, esophagus; *M*, mucosa. *I*, inactive condition; *II*, hypopharyngeal bar Type I; *III, IV, V*, hypopharyngeal bars Type II. In *IV* the diverticulum spurium oesophagi is indicated by *d*. In *V* the diverticulum spurium oesophagi is indicated by *d*, the diverticulum spurium hypopharyngis by d_1.

In previous studies [9] I have considered Type II of the hypopharyngeal bar as the result of a hyperexcitability of the sphincter muscle. This concept requires further elaboration. It would be conceivable that Type II is simply caused by a greater dislocation of the larynx in Valsalva's experiment, inasmuch as we know that dislocation of the larynx does cause a contraction of the sphincter muscle. In other words, if the dislocation of the larynx is moderate, the hypopharyngeal bar forms Type I; if the dislocation is more pronounced, Type II is formed. This concept would imply that the form of the hypopharyngeal bar is dependent exclusively on the dislocation of the larynx and not on muscular excitability.

In order to answer this question I have examined the x-ray films which were taken of 40 persons performing Valsalva's experiment. In 20 persons there was a hypopharyngeal bar Type I and in 20 persons there was a hypopharyngeal bar Type II. In all of these films the width of the hypopharynx was measured at a level of 4/16 in. (0.64 cm.) above the floor of the hypopharynx. The Table shows that in a hypopharyngeal bar Type I the width of the hypopharynx varies most frequently between 4/16 and 6/16 in. (0.64 and 0.96 cm.), in a hypopharyngeal bar Type II from 5/16 to 10/16 in. (0.9 to 1.6

Width of Hypopharynx in Hypopharyngeal Bar Type I and Type II

Type I		Type II	
Width In.	No.	Width In.	No.
3/16	1	4/16	1
4/16	6	5/16	3
5/16	5	6/16	1
6/16	4	7/16	4
7/16	2	8/16	3
8/16	2	9/16	3
	20	10/16	3
		12/16	1
		15/16	1
			20

Fig. 5.—Lateral exposure of a normal hypopharynx and a normal esophagus. *VI* indicates the sixth vertebra.

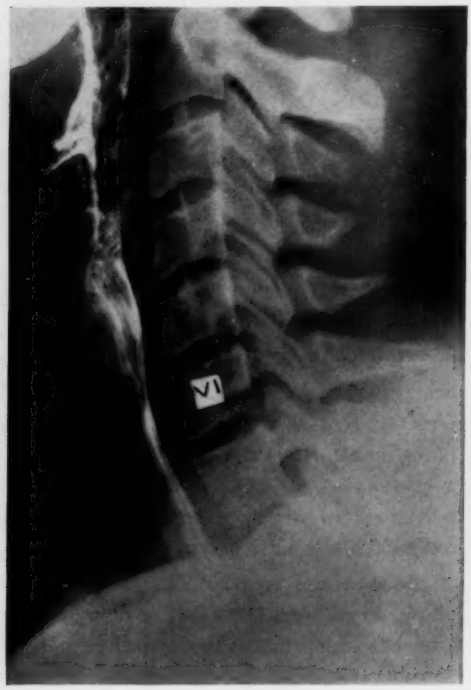
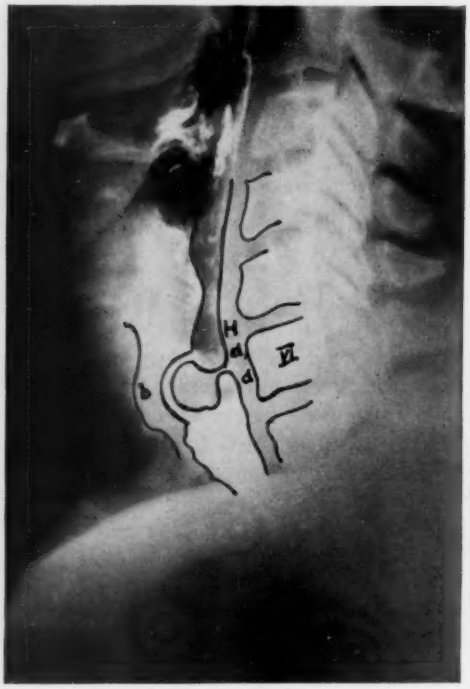


Fig. 5*a*.—Taken during the performance of Valsalva's experiment. *H*, dilated hypopharynx; *b*, hypopharyngeal bar; *d*, diverticulum spurium oesophagi; d_1, diverticulum spurium hypopharyngis; *VI*, sixth cervical vertebra. Note that the two diverticula spuria are almost in contact.



cm.). These figures are only approximations because exact measurements cannot be taken on routine x-ray films. Nevertheless, the figures prove that in instances of a hypopharyngeal bar Type II the hypopharynx is, as a rule, wider than in instances of a bar Type I although the difference is not conspicuous. Since the width of the hypopharynx is proportionate to the dislocation of the larynx, the formation of the hypopharyngeal bar seems actually to be dependent on the dislocation of the larynx in Valsalva's experiment. However, there are cases in which a narrow hypopharynx is associated with a hypopharyngeal bar Type II and vice versa. This proves that the dislocation of the larynx cannot be the only factor which is responsible for the form of the hypopharyngeal bar. In addition, there must be a specific nervous mechanism which controls the contraction of the sphincter muscle, similar to the nervous mechanism which controls the relaxation of the muscle. It is this nervous mechanism on which the excitability of the sphincter muscle depends.

For practical purposes it must be remembered that the evaluation of the hypopharyngeal bar must take in consideration both the type of the bar and the width of the hypopharynx. The finding of a hypopharyngeal bar Type II per se does not permit the definite diagnosis of muscular hyperexcitability. However, if this finding is associated with a comparatively narrow hypopharynx, viz., with a hypopharynx the width of which does not exceed 4/16 to 5/16 in., the diagnosis of muscular hyperexcitability is justified.

In the present series of 20 cases there were 4 cases in which there was a hypopharyngeal bar Type II associated with a comparatively narrow hypopharynx, viz., below 6/16 in. in width. According to the presented concept in these cases the diagnosis of muscular hyperexcitability is justified. From the clinical point of view it is interesting to note that

Fig. 6.—X-ray film of a man aged 78, who did not complain of trouble in swallowing. Figure shows an osteoarthritis of the cervical spine, a spontaneous hypopharyngeal bar (*b*) and an "inconstant diverticulum" (*x*).

Fig. 6*a* (Same patient).—Taken during the performance of Valsalva's experiment. The hypopharyngeal bar (*b*) is markedly increased (Type II); the "inconstant diverticulum" only slightly larger.

the hyperexcitability of the sphincter muscle does not necessarily result in subjective symptoms, viz., trouble in swallowing, feeling of a lump in the throat, or other difficulties. In fact, among the four cases of true hyperexcitability of the sphincter muscle only one patient complained of swallowing troubles; in another case clinical notes in this respect are not available; two patients did not complain of any troubles although in one of these two cases there was, in addition to the hyperexcitability of the sphincter muscle, a small "inconstant" diverticulum [5] of the hypopharynx (Figures 6, 6*a*). To sum up, disregarding the diagnosis of muscular hyperexcitability (Holmgren [5]), trouble in swallowing or feeling of a lump in the throat is more frequently noticed in instances of excessive hypopharyngeal bar than in instances of moderate hypopharyngeal bar (60% : 30%) according to the present statistics. Neither the finding of an excessive hypopharyngeal bar per se nor the finding of an excessive hypopharyngeal bar associated with a comparatively narrow hypopharynx (true hyperexcitability) permits the conclusion that the patient will complain of swallowing difficulties or a lump in the throat.

The hypopharyngeal bar is absent in injuries to the larynx, in myasthenia gravis, and in bulbar poliomyelitis. In unilateral recurrent laryngeal paralysis the hypopharngeal bar is noticeable.

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Treatment of Tic Douloureux by Block or Section of the Great Auricular Nerve

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Trigeminal neuralgia, or tic douloureux as it is commonly known, is one of the most painful afflictions which can harass the face of man. Fortunately it is not a common syndrome, but with the first case which is presented to the otolaryngologist he is at once impressed by the formidable obstacle which it presents. Especially is this true when one observes a susceptible patient at the moment of the onset of the attack. One is then sharply impressed with how precarious the continued peaceful existence of such a patient must be. The merest chance brushing of a wisp of cotton against the face at the initial point of attack, the so-called trigger zone, usually on the cheek near the angle of the mouth, and a hitherto comparatively comfortable person becomes a writhing wretched human being in the clutches of a lightning-like paroxysm of pain.

Since the seat of the pain is usually in or about the trigeminal ganglion deep within the skull, it will readily be seen that relief of this condition has presented a difficult hurdle in the past. Ramifications from this nerve center extend in their sensory branches and distributions throughout the deep and superficial regions of the affected side of the face: The cheeks sweat, the eyes bulge, and the victim writhes with hands clutching fiercely at the head. Of the involved nerves the ophthalmic is usually little affected. It is the maxillary and mandibular branches and their distributions which mainly bear the brunt of the attack.

Treatment in the past has been almost entirely devoted to surgical intervention at or near the site of the ganglion of the fifth nerve. But though injection of procaine, infiltration of absolute alcohol and often subsequent section of the involved nerves at their points of emergence from the trifacial ganglion have been done and comparative relief has been obtained, still these procedures have invariably been approached with great wariness and caution by the surgeon undertaking the task. The approach to the ganglion is fraught with great difficulty and with ever greater danger as the critical point is reached. As it lies in the shallow depression on the front of the petrous pyramid of the temporal bone and between this structure and the greater wing of the sphenoid bone, it will be seen in Figure 1 how wary one must be in the approach. For a glance at the dissected cadaver's head as well as this diagram will convince the bravest that the almost always affected mandibular branch is probably the most deeply set of all of the cranial nerves, and that the maxillary ramification is scarcely less so. Too, the mandibular branch, supplying sensory innervation to a large part of the lower region of the face, has the entire motor root lying so closely with it that the latter is adherent to the sensory mandibular branch during a large part of its course and does not stray until the respective muscles are attained.

Besides the difficulty of the approach, the production of any degree of analgesia by injection or section of the trigeminal ganglion or of its branches usually has brought in its wake complications almost as troublesome as the original pain itself. Profuse periodic sweating even after successful infiltration and injection has resulted, as well as marked flushing, repeated attacks of deep-seated and

superficial pain of the face and of the homolateral side of the neck, and commonly marked ectropion of the lower lid of the eye on the successfully injected side of the face. Also noted after treatment of the trigeminal ganglion and/or its sensory roots has been periodic swelling of the previously affected cheek, tingling of the face, and occasionally even more profuse lacrimation from the eye than had existed before the original attacks may have been brought to a temporary, seldom permanent, end.

area of the skin is innervated by multiple fibers which approach from different areas to supply sensation to each area of skin and glands, then, it has been suggested by Wyburn-Mason,[1] this is also true of the area primarily supplied by the ramifications of the trigeminal nerve. A study of Figure 2 will show how true this must be of the side of the face and the adjoining area of the neck.

The attention will immediately be drawn, especially if regard is directed to the sensory innervation in the region of the trigger zone

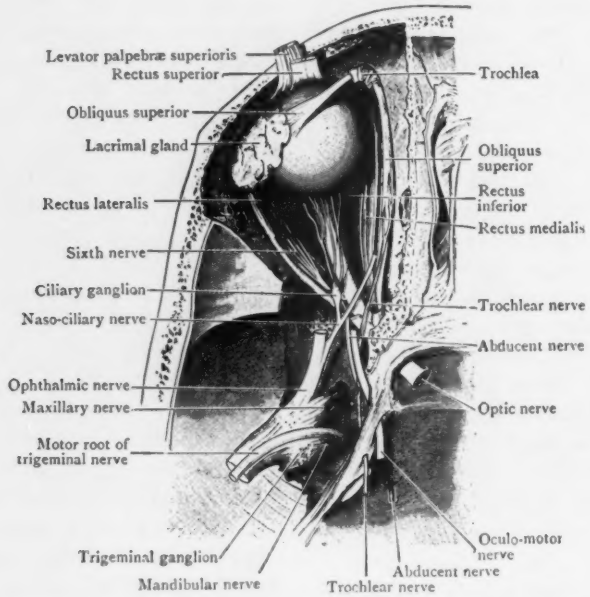

Fig. 1.—Dissection of the orbit and the middle cranial fossa. Both roots of the fifth nerve, with the trigeminal ganglion, are turned laterally. (Reproduced with permission from Cunningham's "Manual of Practical Anatomy," Oxford Medical Publications, Ed. 9, New York, Oxford University Press, 1935, Vol. 3.)

It has thus been felt that often the cure is quite as bad as the original affliction had been. It has been thought that with such a comparatively hazardous procedure more of a result should be obtained. Therefore a solution from another direction has been sought. If, as physiologists have shown, there is marked and constant overlapping of the sensory area of the head and neck by many of the spinal nerve innervations with those of the cranial nerves, and if, as the British anatomist Weddell has suggested, each unit

at the angle of the mouth, to the great auricular nerve. It will be noted at once that this nerve may afford a simple approach. One of the long cervical sensory nerves, it originates posteriorly from the base of the neck, crosses the posterior border of the sternocleidomastoid muscle, lies on its lateral aspect while rising still, and divides near the angle of the jaw into a posterior and an anterior branch. The great auricular being entirely a sensory nerve, one is at once struck, in dissecting it out on the cadaver, with its in-

Fig. 2.—Diagram of sensory nerves of the scalp and face, showing terminal sensory innervation of the great auricular nerve and the large area in the face and neck in which it shares innervation with the facial and trigeminal nerves: (*1*) great occipital; (*2*) small occipital; (*3*) auricular branch of the pneumogastric; (*4*) great auricular; (*5*) auriculotemporal; (*6*) temporal branch of maxillary nerve; (*7*) supraorbital; (*8*) supratrochlear; (*9*) malar branch of maxillary nerve; (*10*) infratrochlear; (*11*) nasolobular; (*12*) infraorbital; (*13*) buccal branch of nerve; (*14*) mental. (Reproduced from "Holden's Anatomy," Ed. 7, Philadephia, P. Blakiston's Son & Co., 1901.)

numerable, fine terminal ramifications in the entire region which is also innervated by the sensory supply of the trigeminal and the facial nerves.

The number of terminal rami which ascend from the anterior and posterior branches of the great auricular nerve is literally endless; those from the posterior branch to intertwine in fine rami with those from the posterior auricular branch of the facial and together to innervate the skin region of the mastoid area, and those of the anterior branch to unite, and together to communicate sensation to the face, cheek, and chin from the neural network both lay down within and all around the parotid gland.

A series of anatomic dissections on a group of cadavers will make amply clear the incomparably greater ease of approach to the great auricular as compared with the trigeminal nerves. The major landmark for the surgical approach is the longest of the major muscles of the neck, the sternocleidomastoid. One need merely to incise the skin at the proper point to come almost immediately upon the great auricular nerve as it pierces the deep cervical fascia of the neck. From here it can be followed obliquely and upward on the lateral surface of the muscle to the area in which it divides into the anterior and posterior branches as described above.

I have, therefore, in acute attacks of trigeminal neuralgia commonly thought it best first to inject or section the great auricular instead of the trigeminal ganglion or its effluent nerve supply. It is simpler, safer, and apparently as effective as the very difficult trigeminal approach, The latter can be subsequently done, although I have found the trigeminal approach no more effective, for the most part. At least this has been so in my hands.

The technique of the method is very quickly described. The patient is placed prone on the operating table with the affected side uppermost. A small pillow is firmly placed against the lower side of the neck beneath the ear and the chin directed downward above the pillow so that the sternomastoid muscle is in a straight line and on the stretch. The muscle at once stands out and crossing it upward and in an oblique direction is seen the course of the external jugular vein. It is at this point, if the tip of the finger or thumb is pressed firmly into the neck, that an acute point of pain will be elicited. This is usually at the junction of the upper two-thirds with the lower third of the sternomastoid muscle, and it is at this point that the injection or the incision and section of the great auricular nerve is done. With the use of procaine, 2%, an intracutaneous wheal is made at this point. The point of maximum tenderness elicited by pressure by the end of the thumb is entered with the point of the needle at the posterior border of the muscle at the junction of the lower third with the upper two-thirds, the point is made to penetrate until the deep fascia is felt, with its slightly greater resistance to further pressure (usually no more

than ¼ in. [0.6 cm.]), and a small amount of procaine is injected (Fig. 3). The needle is not withdrawn, but the area about this point is further infiltrated in all directions under the skin. Usually about 2 cc. will suffice. If alcohol is to be subsequently used, absolute alcohol is very sparingly introduced with the same method previously described. Usually 0.5 to 1.0 cc. will suffice. If section of a portion of the nerve is to be done, after the infiltration with procaine, a small incision is made. One comes almost at once upon the nerve as it emerges at the posterior border of the muscle, turns the border, and comes to lie on the lateral aspect. An inch or two of the nerve may then be sectioned and withdrawn and the skin sutured.

A typical case will emphasize the point.

W. T. K., a man of 75, was first seen at my office on Sept. 2, 1954. For many years he had suffered periodic, recurrent attacks of pain involving the right side of the head, being particularly severe in the right forehead, back of the right ear and right mastoid region, and radiating with great severity to the right cheek and downward to the right side of the neck. The bouts of pain had become more and more frequent and more and more severe as time went on. The attacks would start in the anterior part of the cheek just above the angle of the mouth and would be accompanied by flushing of the face, lacrimation from the right eye, and a facial paresthesia which would manifest itself first by tingling and then by alternate hot and cold "flashes" of great wave-like rapidity. The onset was always sudden, and the patient was never aware when the attacks would begin. Occasionally they would be brought

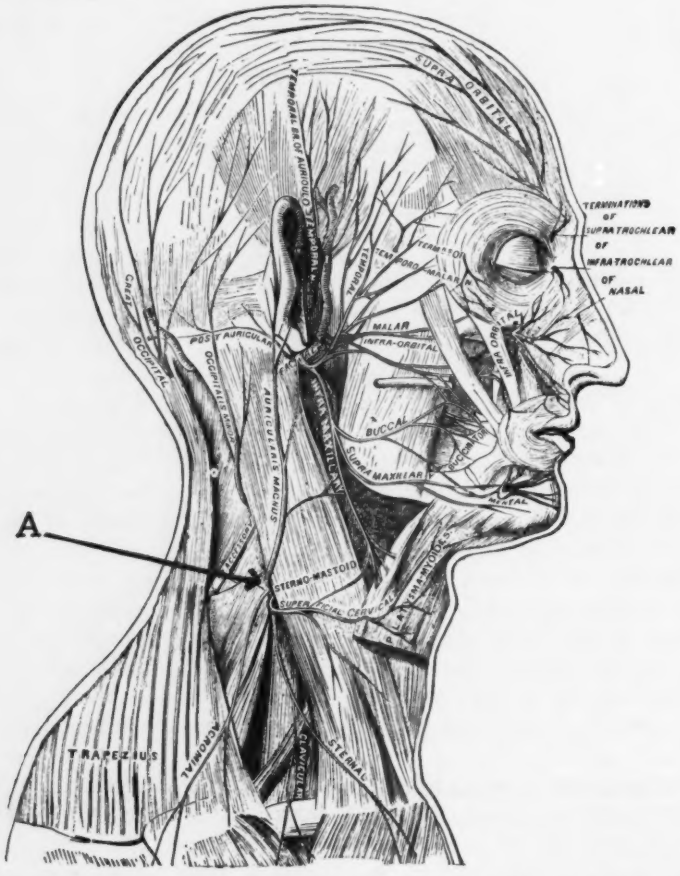

Fig. 3.—The course of the great auricular nerve. *A*, point of injection and/or section of the great auricular nerve. (Reproduced from "Holden's Anatomy," Ed. 7, Philadelphia, P. Blakiston's Son & Co., 1901.)

on by brushing his face lightly upon drying his face with a towel and sometimes merely by blotting his cheek after any lacrimation of the right eye. As a result he lived in a state of constant apprehension, never knowing when at attack would begin.

About two years before I saw him, having come "to the end of my patience," as he put it, he had gone to a qualified neurosurgeon, who had performed an alcohol block of the trigeminal ganglion and its three efferent sensory roots.

This had been followed by the cessation of the deep sensory pain, and the attacks had not recurred for about a year, but the patient had almost at once become afflicted with what was to him a new series of major complaints. His lower right lid had become markedly ectropic, and the ectropion had been the cause of a constant and marked lacrimation. In addition, there resulted occasional shooting pains which seemed very deep and, though momentary, had been quite severe. Also there was occasional spasm of the facial muscles.

About six months before I first saw the patient, after about a year of comparative comfort except for the extremely annoying ectropion and profuse lacrimation, the major attacks of trigeminal neuralgia with typical marked facial and muscular spasm had again begun to recur with almost as great intensity as before the infiltration of the sensory rami of the trigeminal nerve.

When I first saw him he was in great pain and in marked discomfort. To the typical picture of tic douloureux as described above had been added the profuse lacrimation caused by the flaccidly hanging and protruding right lower lid. The injection of the trigeminal ganglion two years before having brought in its wake an unhappy train of events, I decided that the attempt at amelioration should be directed to the great auricular nerve.

The great auricular nerve was very easily localized. Infiltration with procaine had hardly begun when almost at once the pain was relieved, even before the small transverse incision into the skin of the neck had been made at the posterior border of the sternocleidomastoid muscle at the point of junction of the lower third with the upper two-thirds of its length. I came upon the nerve almost at once, lying on the deep cervical fascia. About 2 in. (5 cm.) of the nerve was sectioned and the wound closed in two layers of interrupted sutures.

Relief has thus far been marked as to superficial and deep sensations of pain. The patient has remained relatively comfortable, and although but a few months have passed he states that this has been the longest time in quite a number of years during which he has been relatively relieved. There have been occasional twinges but little more.

The ectropion and lacrimation, of course, remain the same as they were before, apparently because of lack of regeneration of the efferent nerve fibers to the lower lid. The very severe pain due to the renewed tic douloureux, however, is gone, at least for the present.

SUMMARY AND CONCLUSIONS

A method of treatment of trigeminal neuralgia is presented. It is advocated that all attacks of tic douloureux and most of those which simulate this condition may be treated by infiltration, injection and/or section of the great auricular nerve instead of the fifth cranial. The former is vastly simpler in execution and seems to have essentially as efficacious a result.

It is urged that treatment of the great auricular be used in every case before the patient is asked to undergo the difficult and hazardous operative procedures on the deep-set trigeminal ganglion or its three sensory nerves.

Although the method advocated is far from a panacea, it is hoped that further attention will be directed toward the cervical spinal nerves in the treatment of the pain syndromes involving the head and neck, even though the latter may be primarily due to the cranial nerves.

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Aging Skin, a Surgical Challenge

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"The days of our years are threescore and ten; and if by reason of strength they be fourscore years, yet is their strength labor and sorrow." [1] So chanted the psalmist. Modern medicine gives promise of pushing ahead this limit to ages beyond that set by the Biblical goal. A life expectancy of 50 years at the beginning of the 20th century has been extended to one of 68 years.[2] But of what value is longevity if old age is to be "the tomb of the living" (Martin Luther), or, in the words of Ecclesiastes, "Thou shalt say I have no pleasure in them." [3]

Until the geriatrician has learned to prevent or postpone one of the most unpleasant features of senescence—facial wrinkles—the surgeon can do much to enrich these added years and help make them fruitful and happy ones.[2]

It is becoming more and more evident that for economic, social, and psychologic reasons —especially when wrinkling occurs prematurely—rhytidectomy has a definite place in surgery. In this connection Gillies [4] states:

> It is not everybody's good fortune to grow more graceful and beautiful in advancing age. The operations for removal of eyelid wrinkles, cheek folds, and fat in the neck are justifiable if the patients are chosen with honest discrimination.

Unfortunately, the operation has been brought into disrepute by commercial exploitation on the part of the opportunist and overoptimistic dramatization by publicity-wise agencies. For example, an editorial in the *New York Times* * entitled "War Surgery" has this to say:

> The other night at the Academy of Medicine Sir Harold Gillies, the famed plastic surgeon of London, here on a lecture tour told this tale: A very rich social lady spent all of her spare time on beauty treatments, her face was her sole interest. She came to Sir Harold before the war and had her face lifted to erase some wrinkles. . . . When England went to war she threw herself into war work, ran canteens, looked after the wounded and became a well known figure in her charitable activities . . . with complete disregard for personal safety. This eventually told on her and neglect brought back the ugly wrinkles. She appealed to Sir Harold, who was busy on soldier surgery but he knew of the great work she was doing. . . . He was so impressed by her sacrifice for others that he took time off from his own strenuous routine to again restore her beauty . . . a well earned reward.

For reasons given above, surgeons have been reluctant to report their experiences, and as a result there has been little pooling of ideas as to indications, contraindications, and techniques. In consequence, operations that have been found useless or dangerous are still being repeated by the novice.

The purpose of this paper is to forewarn the beginner against the use of methods which we, through sad experience, have found to be disappointing.

ANATOMIC AND PATHOLOGIC CONSIDERATIONS

Anatomically, the face is composed of an armature of bone and muscle, covered by skin stretched at right angles to the muscle pull. Its elasticity permits it to adapt itself smoothly to fluctuations in weight and distortions of the face in expression.

* Quoted by Cook.[5]

Histologically, the aging skin is characterized by progressive diminution in the yellow elastic fibrils and their replacement by inelastic collagenous tissue. Owing to atrophy of the subcutaneous fat and reduction in muscular and skeletal mass, the overlying skin, having lost its elastic recoil, can no longer adapt itself to the diminished volume and in consequence gravitates to the lower parts of the face.[6]

The contraction of the collagenous fibrils throws the overlying skin into a series of elevations and depressions. In time, the action of the muscles upon the friable skin causes the fibrils to break, as evidenced clinically by fine white lines.

CLINICAL CONSIDERATIONS

Before surgery is undertaken, the patient should be informed as to the probable results of the operation, its duration, the location and extent of scarring, and the potential complications.

Each individual must be critically studied from both an emotional and an operative standpoint, with a view to determining whether or not surgical intervention will be of actual benefit.

1. *Emotional Standpoint.*—In the well-adjusted and properly selected patient the result is likely to be satisfactory; but those emotionally unstable are difficult to please and are best left alone, even though considerable improvement might be obtainable. To paraphrase Baker and Smith,[7] it is this group which forms the exasperating, disturbing chore for the surgeon who has obtained an excellent technical result. In these patients operation merely serves to interrupt the rationalization process; and it is likely that the

Fig. 1.—Operation highly selective. *A*, will give most promising result. Minimal destruction of elastic fibrils, no breaks in collagenous tissue, and but little fatty infiltration. *B*, will give unsatisfactory result. Extensive destruction of elastic fibrils, irregular lumpy deposits of fat in lower part of face and neck. Broken connective tissue seen as white depressed scars.

resulting scar or some other trivial defect will be seized upon for continuation of the delusional and illusional construction, which is often frankly schizoid. The psychiatric service can aid the surgeon in recognizing such potential reactions.

2. *Operative Standpoint.*—The operation is highly selective. The most promising results may be expected in those patients whose skin hangs in folds and shows a minimal destruction of the elastic fibrils, no breaks in the collagenous fibers, and but little fatty infiltration (Fig. 1*A*). In the hypertrophic type, characterized by fatty infiltration, with irregular lumpy deposits of fat in the lower part of the face and neck, the benefits are likely to be too transitory to justify the inconvenience of surgery, as these deposits will reappear in a period of weeks or months. The atrophic type is evidenced by a loss of fat, causing the eyes to appear sunken, the cheeks fallen in, and the bony prominences more pronounced. In the neck the fibrosis of the platysma causes the cheeks to hang down like "dewlaps." During forced contraction of the muscle, fibrous cords stand out in ridges, and in periods of relaxation the skin below the mandible either sinks as a pure redundancy or becomes "doubled." "Ironing out" of the skin is apt to cause the face to assume the fixed expression of a wax figure. In the degenerative type the skin is dry and thin, showing nonelevated pigment patches of a yellowish-brown color, with telangiectatic blood vessels coursing beneath the surface. The appearance of the skin is that of dry, rumpled tissue paper. Broken connective-tissue fibrils are seen as white depressed scars, especially around the eyes and mouth. There is a loss of resiliency, so that when the skin is picked up between the fingers, the fold tends to remain. A mere stretching of the skin cannot be expected to correct the degeneration or to restore the continuity of the ruptured, adherent connective-tissue fibrils. We have operated on such patients, only to find that the remaining white lines cast shadows as deforming as the wrinkles themselves (Fig. 1*B*).

OPTIMAL AGE FOR OPERATION

No categorical answer can be given to the question of the optimal age for operation, owing to the wide difference between chronologic and anatomic age. As in all operations, the procedure is more effective as a prophylactic than as a therapeutic measure. Generally speaking, probably the best results can be obtained in persons between the fourth and fifth decades, at which time connective-tissue fibrils are usually still intact. The presence of elastic tissue, however, which progressively atrophies, will tend to cause a comparatively early reappearance of the wrinkles. Fortunately, in this age group the effects of subsequent operations are likely to be less transitory, since after each surgical procedure the elasticity of the skin is reduced. In patients beyond the age of 50, although the duration of the benefits will be longer, the results will prove less satisfactory because, as mentioned before, the broken connective-tissue bands will cast shadows nearly as deforming as the wrinkles.

AVERAGE DURATION AND RESULTS OF OPERATION

Erroneous impressions have become so widespread, both in the professional and in the lay mind, as to the infallibility of this surgery that the utmost conservatism must be employed in informing the patient concerning the duration of the beneficial results. It should be pointed out that the operation merely conceals the outer manifestations of senescence and is by no means to be considered one of rejuvenation. It may well be compared with the painting of a house. The immediate effect is always good; but as time progresses, the house becomes more and more soiled, the rapidity depending upon the changes in temperature and atmospheric conditions, such as the presence of smoke, acid, dust, etc. Just so, in the facial skin there will be a gradual recurrence of the wrinkles, depending on hereditary predisposition to skin degeneration, fluctuations in body weight, age, profession, and habits. For instance, in those who make excessive use of

the mimic musculature, such as actors or persons who give way to frequent emotional outbursts, the effects will be less lasting.

Generally speaking, the results are excellent the first year, good the second year, and fair the third year. By the fourth and fifth year a revision will usually be necessary.

The cosmetic improvement is equal to the subtraction of 10 to 15 years. It is manifestly impossible to create an appearance of 30 in a person of 60. While the wrinkles in the skin can be eradicated, there are other manifestations of age which cannot be eliminated, such as desiccation, diminution in the volume of the facial skeleton, and atrophy and flabbiness of the facial musculature.

POTENTIAL COMPLICATIONS

Aside from those associated with any surgical procedure, complications are not often encountered. Occasionally, an epicranial branch of the seventh nerve is severed, and a partial paralysis of the muscle on the affected side follows. Fortunately, this in time disappears. Any Oriental distortion present about the eyes will vanish in a day or two. Some edema, with a sense of tautness, a certain amount of discoloration, and perhaps subconjunctival ecchymosis are to be expected, but these will subside within a week. Hematomas should be evacuated as soon as found. Stretching of the scar may occur if the skin margins were sutured under undue tension. In such an event, removal of the stretched cicatrix must be postponed until healing is complete. Any tendency to hypertrophic scar formation is counteracted by irradiation therapy. Should the ear lobule have been inadvertently caught in the scar and displaced, the technique for its replacement is similar to that employed for the correction of an attached lobule.[8] Probably the most serious complication is ectropion; this should be attended to immediately for the protection of the eye.

PITFALLS IN TECHNIQUE

The early operations for the eradication of wrinkles (Figs. 2 to 6)—Lexer (1906), Hollander (1912), Joseph (1912), Passot (1919)—had little to recommend them. Their effect depended entirely upon the amount of tension exerted on the skin in closure, and the subsequent action of the mimic musculature on the tensed skin caused an early reappearance of the wrinkles. Lasting benefits can be obtained only by (1) rotation of large flaps and their fixation to the inelastic fascia; (2) elimination of the muscle pull, to prevent recurrence, and (3) avoidance of all tension on the skin, to do away with marginal sloughing and stretching of the scar.

1. *Rotation of Flaps.*—One flap is raised in front of and one behind the auricle. The separation is done under direct vision, so that bleeding vessels can be ligated. If it is done blindly, control will be difficult, with a likelihood of hematoma formation and its disturbing consequences. The undermining is carried out in the plane immediately above the aponeurosis. This minimizes bleeding and eliminates the danger of damage to filaments of the facial nerve, parotid gland, and parotid duct. Undermining between the skin and subcutaneous fat is likely to lead to sloughing of the skin, since it destroys the nutrition of the part, which is derived from that layer. The extent of separation is determined by the amount of rotation necessary to overcome the wrinkling. Any excess above the line of incision is excised.

2. *Elimination of Muscle Pull.*—With the flaps in place, recurrence is due either to the continuation of the involutional process of aging or to the action of the musculature. The former is a problem for the geriatrician, the latter for the surgeon.

The facial muscles may be divided into three groups: (*a*) those which have to do with vision, (*b*) those concerned with mastication, and (*c*) those needed for expression. Only the last group is of interest in this connection.

The expression muscles are dominated by three sphincters surrounding the orifices of the face—the orbicularis oculi about the orbital region, the orbicularis oris around the mouth, and the nasalis covering the nose.

To prevent recurrence of the wrinkles, the pull of the mimic musculature on the skin must be either inhibited or eliminated. Here the choice lies between wrinkling and a diminution or loss of expression. In the case of glabellar and forehead wrinkles, the destruction of the activity of the procerus, corrugator, and/or epicranius offers no problem, since it eliminates merely expressions which can be dispensed with, such as anger and aggressiveness. The real difficulty arises in the case of wrinkles about the eyes and mouth, for here the sphincter muscles perform functions too important to be disturbed.

3. *Avoidance of All Tension on Skin.*—In suturing, tension on the skin must be reduced to a minimum; otherwise, there will be sloughing of the margins of the wound and/or stretching of the scar, with a recurrence of the wrinkling. Tension on the skin is prevented as follows: Tucks are made in the fascia by folds pinched up at strategic points and secured with fine absorbable sutures. This maneuver is supplemented by the use of an absorbable or tantalum suture, which is made to pick up the deep tissues of

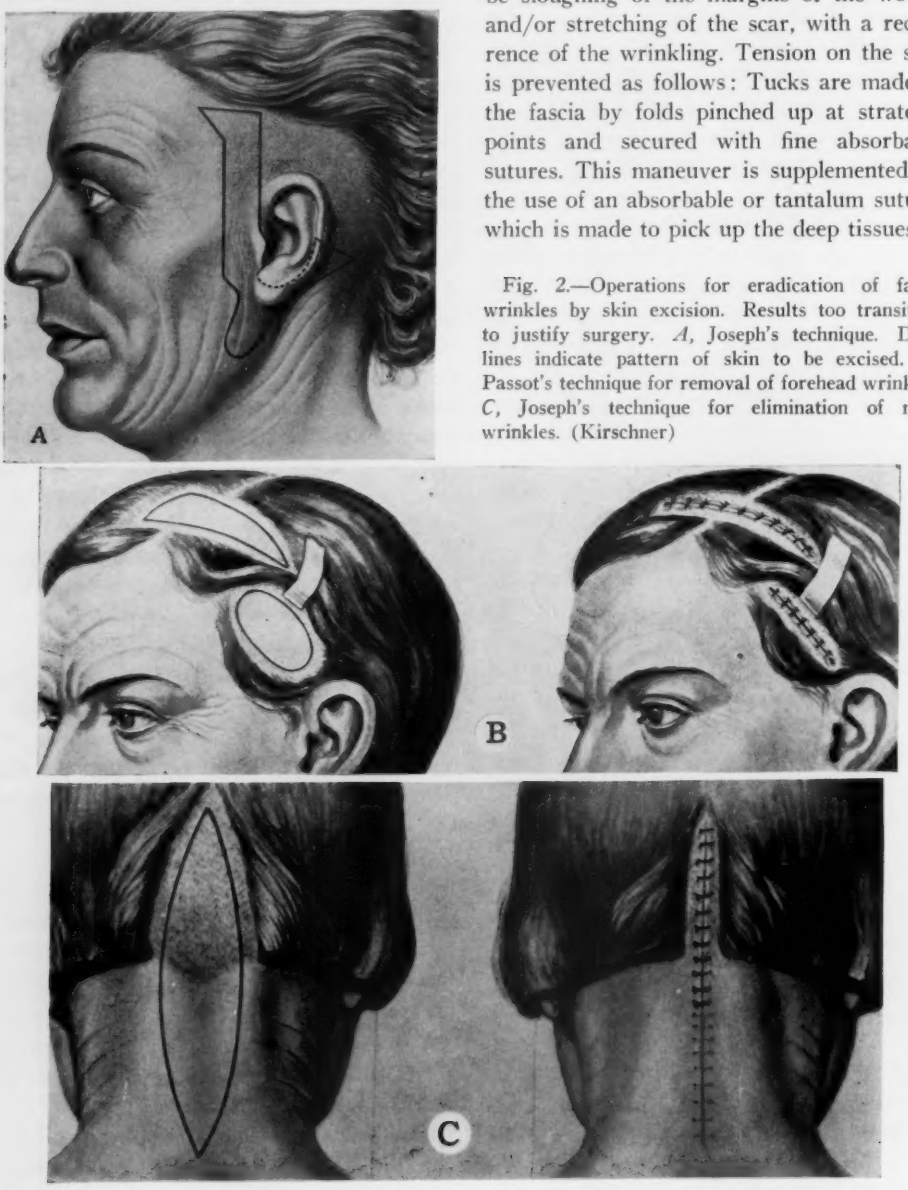


Fig. 2.—Operations for eradication of facial wrinkles by skin excision. Results too transitory to justify surgery. *A*, Joseph's technique. Dark lines indicate pattern of skin to be excised. *B*, Passot's technique for removal of forehead wrinkles. *C*, Joseph's technique for elimination of neck wrinkles. (Kirschner)

Fig. 3.—Operation for removal of glabellar wrinkles. *A*, dotted line indicates pattern of skin excision. *B*, wound sutured. This procedure leaves hypertrophied scars more disfiguring than original wrinkles. (Kirschner)

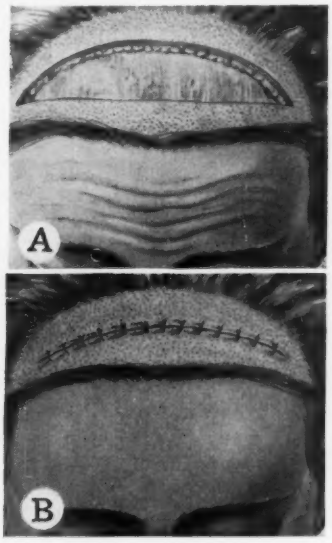
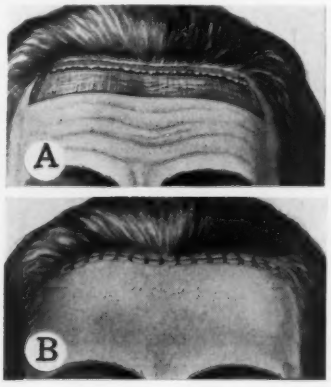


Fig. 4.—Joseph's operation for removal of transverse forehead wrinkles. *A*, pattern of spindle-shaped excision within hairline. *B*, wound closed. The results of this operation are too transitory to justify its use. (Kirschner)

Fig. 5.—Passot's operation for removal of transverse forehead wrinkles. *A*, pattern of trapezoidal excision at hairline. *B*, wound closed. The results of this operation are too transitory to justify its use. (Kirschner)



the cheek at the limit of the skin undermining and looped over the zygoma. To insure against a disturbance in the adhesion between the flap and the underlying aponeurosis, the parts are splinted with tantalum loops passed through muscle and brought out in the scalp behind the incision.[6]

In cases of mild dermoptosis the operation is done in one stage; but if extensive undermining is necessary and furrows must be elevated, it is performed in two sittings. In the first operation the wrinkles in the eyelid and forehead are corrected, as well as those of the temporal and upper-facial region. At the second stage, three weeks later, the wrinkles in the malar, mandibular, and cervical areas are eradicated.

GLABELLAR WRINKLES

Glabellar wrinkles may be single or double. When due to the action of the procerus muscle, they will be transverse; and when caused by the corrugator, vertical or oblique. They occur early in life and are removed, not so much for cosmetic reasons, but because they give the person a stern or aggressive appearance.

Eradication by excision is definitely contraindicated, for, despite the most scrupulous technic, it is bound to leave hypertrophied scars more disfiguring than the original wrinkles [10] (Fig. 3). Nor can they be eliminated by a lateral tightening of the skin through temporal incisions [9] (Fig. 2). The safest procedure is the following [6]: An incision is made at the inner margin of the eyebrow, the skin is undermined over the glabellar region, and the corrugator and procerus muscles are cut subcutaneously to prevent recurrence of the wrinkles. If the wrinkles are deep and the connective-tissue fibrils ruptured, correction is best achieved by means of a dermal graft. The wound in the eyebrow is then closed.

FOREHEAD WRINKLES

Forehead wrinkles cannot be eliminated by spindle-shaped skin excisions made parallel to or within the hairline [9] (Figs. 4 and 5).

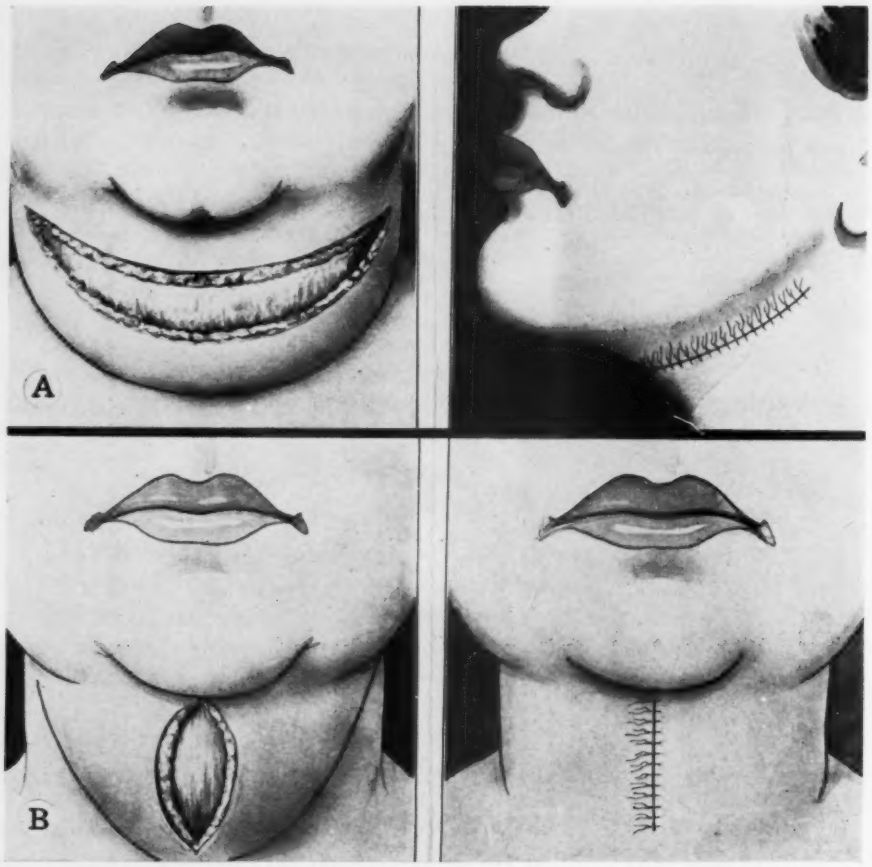


Fig. 6.—Operations for removal of neck wrinkles and double chin by spindle-shaped excision in anterior neck region. These leave hypertrophied or depressed scars more disfiguring than original deformity. *A*, spindle-shaped horizontal resection of redundancy. *B*, spindle-shaped vertical resection. (Miller)

The results are too transitory to justify the operation. Moreover, should the patient possess a receding hair line, the surgery would obviously be out of the question.

Inasmuch as forehead wrinkles are invariably associated with drooping of the eyebrows, we employ a procedure [6] which eradicates both defects and at the same time leaves an inconspicuous scar. An incision is made along the upper margin of each eyebrow, and the forehead skin is separated from the underlying structures with blunt scissors. As a precaution against recurrence, the epicranial fibers are severed subcutaneously. (While we realize that the procedure is unduly conservative, we have not had the temerity to cut the muscle attachment at the supraorbital ridge and at the epicranial aponeurosis.) After free mobilization, the skin is drawn down over the original incisions until the wrinkles disappear.

Depressed scars resulting from breaks in the connective tissue are elevated with dermal transplants. The excess skin is excised, and the wound margins are approximated. When the eyebrows are thin, the operation is contraindicated, although in women it is often possible to conceal the scar with an eyebrow pencil.

UPPER-EYELID WRINKLES

Upper-eyelid wrinkles may be due to redundant skin, to herniation of the periorbital

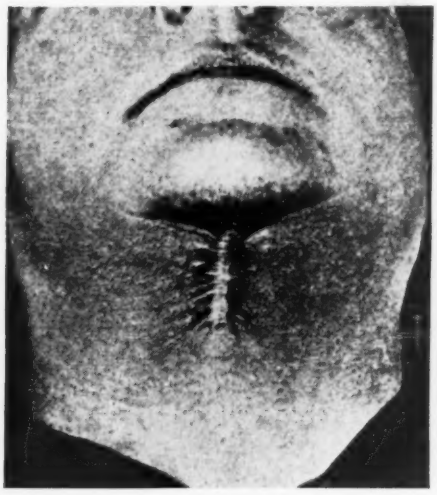
fat through the thin tarso-orbital fascia, or to both. The excess skin is removed, the herniated periorbital fat excised, and the opening in the tarsal fascia closed. Care should be taken not to exert any undue pull on the fatty tissue, or too much of the bright yellow intraorbital fat will prolapse into the wound. The surgery is so planned that the scars will lie in natural folds. For successful results considerable ectropion should develop at the time of operation. This usually subsides in 24 to 48 hours.

LOWER-EYELID WRINKLES

The removal of lower-eyelid wrinkles and pouches represents the most hazardous procedure in rhytidectomy because of the danger of ectropion. Little if any skin should be excised from the palpebral margin. The incision is made parallel to the lashes and not more than 1 or 2 mm. below, so that the resultant scar will be concealed by the cilia. The skin is undermined to the infraorbital rim. Any herniation of the periorbital fat is treated similarly to that of the upper eyelid. The skin flap is rotated outward and upward until the wrinkling and pouching disappear. The palpebral margin is then fixed to the lateral palpebral ligament, and the excess skin is excised.

This operation should err on the conservative side. Any evidence, however slight, of ectropion will prove disastrous. Should this eventuality occur, however, the scar is opened, the lid margin applied to the conjunctiva and the remaining raw area covered with a flap rotated from the upper lid.

Fig. 7.—Scar in submental region from ill-advised incision made to reduce double chin. Note spreading of scar. (From Christopher, F., editor: "Textbook of Surgery," courtesy of Dr. Jerome Webster and W. B. Saunders Company.)



NECK WRINKLES

Neck wrinkles cannot be removed by horizontal or vertical excision of the redundancy [10] (Fig. 6). Even with the most scrupulous attention to details of technique this leaves ugly buckled or depressed scars (Fig. 7), which are difficult if not impossible to eradicate. The best results are obtained by elevating the skin on the neck and rotating the flap upward and backward until the wrinkles disappear. The redundant skin is excised within the hairline of the occipital region.

DOUBLE CHIN

The double-chin deformity appears in several forms: (1) redundant skin with or without accumulation of fat, (2) herniation of the structures on the floor of the mouth, or (3) a combination of the two. The first type is treated in the same manner as are neck wrinkles.[6] The second type still represents a surgical challenge. Correction requires a reconstructive procedure similar to that for the repair of an inguinal hernia. Merely to stretch the skin of the neck would prove as ineffectual as to stretch that over the groin. After rotation of the skin below the mandible backward and upward and excision of the excess in the hairline of the occipital region, recurrence is prevented by an imbrication of the mylohyoid muscle fibers, to strengthen the mandibular floor.

While the procedure is effective in selected cases, it has not become routine, owing to the debatability of the indication.

SUMMARY

The beginner is forewarned against the use of rhytidectomy operations which we through sad experience have found disap-

pointing. Anatomic and pathologic considerations are reviewed. Selection of patient, optimal age for surgery, average duration of beneficial results, and potential complications are discussed. Pitfalls in technique are detailed.

307 Second Ave. (3).

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News and Comment

ANNOUNCEMENTS

Postgraduate Course in Esophageal Speech.—The course will be presented from June 13 through July 1, 1955, under the direction of Nathaniel M. Levin, M.D., F.A.C.S., and staff and is sponsored by the University of Miami School of Medicine.

This course is planned to provide three weeks of intensive work in esophageal speech and organic voice problems for speech therapists, otolaryngologists, and rehabilitation specialists.

Convention of International Association of Laryngectomees.—Laryngectomees from all over the United States and Canada will assemble in Miami during the last week in June. Some have not yet learned to talk and will attend speech classes as trainees.

Traineeships.—Ten traineeships (tuition, traveling expenses, etc.) valued at $250.00 each will be available to qualified persons on application. Forms will be mailed on request. Tuition fee: $150.

Information.—Address all communications to

ELAINE BULMER, R.N., Secretary
1431 N. Bayshore Drive
Miami, Fla.

Special Article

OTOSCLEROSIS

An Index of the Literature, with Abstracts, and An Index of the Authors According to Subjects for 1952-1953

THIS IS the seventh installment in loose-leaf form for insertion in Volume IV, "Otosclerosis." It covers the literature for the years 1952 and 1953 and is published by the Central Bureau of Research of the American Otological Society, Incorporated.* As in previous years, it also contains a few abstracts not obtainable in time for the prior index.

Both original articles and abstracts in the various medical publications have been utilized in preparing this index.

The titles of articles are given in English and the names of the mediums of publication in the language of the original.

Only the opinions of the authors are given, and no endorsement or condemnation should be inferred because of the selection of the articles abstracted. During recent years so many papers on the fenestration operation have been published that they have become almost repetitive in character, and, in consequence, we have abstracted but a few.

A reprint of this installment with index of authors according to subjects and perforated for loose-leaf binding in Volume IV of "Otosclerosis" may be obtained for $1.00 from

EDMUND PRINCE FOWLER, M.D., *Editor*
140 East Fifty-Fourth Street, New York 22.

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Angeluscheff, Z. D.: Biological Problems in Otosclerosis, Acta oto-laryng. **43:** 337-351, 1953.

The author propounds his philosophy of the effects of the sonic-ultrasonic waves continually passing from the environment into the ear structures. He claims that through the action of ultrasonics structural changes may take place in the soft and bony tissues of the organ of hearing. Impedance lesions tend to cut out the intrusion not only of ordinary sound but of ultra sound as well, and therefore such lesions are a defense against further conductive progressive deafness caused by sound vibrations. The author states that with sufficient intensity the so-called "blue coats of Manasse" with stiffening of the ossicle chain could be produced experimentally with sufficient intensity of ultra sound. He believes that lack of hormonal defense, due to heredity or environmental depletion, is a contributory factor.

Arslan, M.: Investigations on the Vasodilative and Hypotensive Function of the Autonomic Plexus of the Petrosal Nerves and the Tympanic Nerve, Confinia neurol. **11:**294-302, 1951.

"Physiological experiments showed that a stimulation of the peripheral end of the facial nerve in the region of the meatus acusticus internus gives rise to a unilateral vasodilation without any change in arterial pressure, i. e. to an active vasodilation. The fibres involved in this process were found to pass through the large superficial petrosal nerve and to rejoin the arteries of the pia mater on reaching the carotid plexus. On the other hand, stimulation of the mucosa of the middle ear around the fenestra ovalis produces an arterial hypotension. The anastomosis between the internal carotid plexus and the tympanic nerve was found to be composed of fibres running from the tympanic nerve to the carotid plexus and not the other way round. Moreover, the tympanic ganglion receives preganglionic fibres from a satellite branch of the stapedial artery and is not a tributary of the tympanic nerve." (Quoted from *Excerpta Med.* Sect. II **5:**117 [April] 1952.) The above implies that the facts quoted are related to certain tumors in the middle ear histologically identical with tumors observed in the carotid gland. The changes in arterial tensions suggest other possibilities.

Bateman, G. H.: Preservation of Hearing After Removal of the Stapes, J. Laryng. & Otol. **66:**570-571, 1952.

Finding the malleus and incus fused while operating for a chronic suppurative otitis media, Bateman severed the malleus at its neck and removed in toto the fused

ossicular mass, the stapes coming away complete and attached to the incus. The postoperative vertigo ceased by the 28th day, and the ear was dry by the 35th day, at which time the audiogram revealed the bone conduction to be normal and the air conduction to be only 15 db. down over the critical speech frequencies.

Bateman, G. H.: A Case of Successful Restoration of the Hearing by Fenestration in Spite of Damage to the Membranous Extrenal Semicircular Canal, J. Laryng. & Otol. **66:**572-573, 1952.

Carhart, R.: Bone Conduction Advances Following Fenestration Surgery, Tr. Am. Acad. Ophth. **56:**621-629, 1952.

Bone-conduction audiograms show a false "otosclerotic notch" in cases of uncomplicated stapedial fixation, and this distorts the picture of the cochlea function. Although after the fenestration operation the threshold curves sometimes suggest an improvement in cochlea function, this change may arise from a lessening of the mechanical distortion. More accurate prediction of surgical results may be obtained if allowance is made for this "notch" by correcting the preoperative bone-conduction audiogram accordingly.

Carrascal, C. B. (Madrid, Spain): Use of Vitamins in Otosclerosis, Fifth International Congress of Oto-Rhino-Laryngo-Broncho-Oesophagology, Amsterdam, June, 1953.

Vitamin B complex appeared to produce the best results when given over a long period, as far as the reduction or suppression of tinnitus was concerned. Nicotinamide produced good results in labyrinthine vertigo. Good results were also obtained with intensive vitamin A and D medication and even vitamin C shock. No satisfactory results were obtained from the administration of vitamin E or from other vitamins in the treatment of otosclerosis.

Clerc, P.: Restoration of Hearing Following Fenestration, Acta oto-laryng. **42:** 334-344, 1952.

To increase the permeability of the fenestra the author employs an exsanguinated full-thickness graft 0.02 mm. thick. This is thinner than a normal tympanic membrane.

Cremin, M. D.: A Case of Fragilitas Ossium, J. Laryng. & Otol. **66:** 92-94, 1952.

The fenestration operation was performed in a case of brittle bones with blue scleras and otosclerosis. A favorable result was achieved.

Del Bo, M.: Histopathological Findings in Otosclerosis, Folia heredit. path. **1:**13-22, 1951.

The histological examination of the petrous bone of an adult who during life suffered no hearing loss is reported. An extensive otosclerotic involvement was revealed in the region of the fissula ante fenestram. The usually observed structure of this region was no longer recognizable. However, both the stapes and round window membrane regions were not involved in the otosclerotic process. The author attributes the deafness in otosclerosis to ankylosis of the stapes footplate in the fenestra ovalis and believes that the involvement of the fissula ante fenestram is an important factor in producing hyperacousia.

Del Bo, M.: Morphogenetic and Morphological Observations on the Enchondral Osseous Stratum of the Human Labyrinthine Capsule, Biol. lat. **5:**68-80, 1952.

The enchondral bone of the labyrinthine capsule appeared to remain unchanged in a patient from the age of 2 years until old age.

De Reynier, J. P.: Cranial Trauma and Otosclerosis, Ann. oto-laryng. **69:** 674-679, 1953.

The author believes that trauma to the cranium may influence the otosclerotic lesion, probably by vascular changes. However, to be able to ascribe any loss of hearing in cases of otosclerosis to cranial trauma, one must ascertain the following: (1) The patient had suffered from otosclerosis before the accident; (2) the loss of hearing became more rapid after the accident than before it; (3) the examination after the trauma eliminated concussion of the labyrinth, inflammatory adhesions in the middle ear, and scar tissue resulting from fractures of the periosteum of the otic capsule.

De Wit, G. (Utrecht, Netherlands): The Use of ACTH (Cortrophine) and the Thiersch Grafts in Fenestration Operations, Fifth International Congress of Oto-Rhino-Laryngo-Broncho-Oesophagology, Amsterdam, June, 1953.

Cortisone, because of its effect in preventing labyrinthitis and scars, was used in connection with the fenestration operation. Using corticotropin (ACTH) in 40 fenestrations and not using it in 40 fenestrations for comparison showed no difference in the results obtained under the two conditions. However, excellent results were obtained under a 14-day administration of corticotropin with removal of the flap only sufficiently to obtain a closed cavum tympani and avoiding covering the fenestra. To the fenestra and the remaining walls a thin graft from the upper arm was applied. In otosclerosis 95% of the results were good, and in adhesive otitis, 70%.

Ferreri, G., and Coen, R.: Calcium Content of the Ossicles in Otosclerosis and in Chronic Hyperplastic Otitis Media, Valsalva **27:** 183-190, 1951.

The ossicles in 15 instances were examined for calcium content. Five were taken from fresh cadavers, and 10 were removed during fenestration operations (6 otosclerosis, 4 chronic adhesive otitis media). There were no abnormal variations in the calcium content in any of the specimens.

Fowler, E. P.: Signs, Emblems, and Symbols of Choice in Plotting Threshold Audiograms, A. M. A. Arch. Otolaryng. **53:**129-33, 1951.

The author briefly outlines the history of the designing of the audiogram chart and the reasons for the choice of the symbols used for plotting the threshold-audiogram curves by air and bone conduction.

In 1920 and 1921, few clinicians even used the term "threshold" and the unit of measure, "decibel," was practically unknown to them. The audiogram chart was devised to enable them to better visualize these terms. The facts and the philosophy underlying the choosing of the frequency octave and intensity scales are set forth, and why it was insisted that in spite of the more factual representation of the

average normal threshold by the curved line a straight line was used and the chart inverted so that hearing losses would appear below the threshold line and not above it, as was customary with the physicists.

The author chose a square to represent the losses by bone conduction when these losses were equal (not necessarily because of the possible suggestion of "square head" or "block head"). Clinicians regularly use outline drawings of the human body, and because, as the picture faces them, the left side of the drawing represents the right side of the body and the right side of the drawing the left (head) and its areas, a bracket ([) is used to the left of the frequency ordinate for the right ear and an opposing bracket (]) to the right of the frequency ordinate for the left ear. These symbols fit nicely around the dot and circle without overlapping and even without touching each other when all plotted points for a given frequency are identical for air conduction and bone conduction, thus [⊙]. No other symbols are capable of doing this unless they are drawn by an expert draftsman or are made to extend far beyond the plotted point, in which case they tend to spread over too much space and confuse the observer. Could anything be more logical, clear and simple?

If colors are used, red (suggesting right) should be used for the right ear and some color, say lemon or lead (suggesting left), for the left ear. Blue also may be used appropriately for the left ear, since the word blue prominently contains the letter "l," suggesting left. It is undesirable to draw a line through to represent the bone-conduction plotted points, because doing so diverts attention from the air-conduction curves and threshold; besides, too many lines are confusing, particularly if they coincide or run near one another.

The audiogram chart should be kept simple; therefore when masking sounds are used, their intensity and frequency should be noted in decibels below the thresholds along the ordinate of the frequency being masked or below the chart. When so-called "white noise" or "thermal noise" is used for masking, the intensity used should be written either on the lower portion or below the bottom of the chart.

The author discusses in detail the present confusion and misunderstandings concerning masking and describes a simple method for overcoming these difficulties.

One reason for the current multiplicity in symbols used in audiograms is that some of the manufacturers of audiometers printed their charts without consulting well-informed otologists. Another reason is that the printers of the standard chart issued by the Advisory Committee on Audiometers and Hearing Aids inadvertently omitted the (.) for the right ear and the circle (o) for the left ear, as approved by its Subcommittee appointed with power to determine the final form of the standard audiogram chart for estimating the percentage in loss of capacity to hear speech. Incidentally, the method adopted for the percentage determinations was a compromise, because, although the air determinations recommended by Fowler were adopted, the bone conduction and binaural varying ratios with differing degrees of deafness recommendations were not adopted for determining percentage loss in capacity. The Committee consisted of Walter Hughson, Paul E. Sabine, and Edmund P. Fowler.

Still another reason for present confusion was a printer's clerical error in the charts prepared for the 2 A audiometer, which reversed the bone-conduction symbols. They were inadvertently printed] [instead of [ ]. All agree that the latter arrangement is far preferable.

Fowler, E. P.: Report of the Board of Trustees of the Research Fund, Central Bureau of Research, to the American Otological Society, Inc., Tr. Am. Otol. Soc., pp. 292-296, 1952-1953.

Fox, G. M.: Otosclerosis in Identical Twins: Result of Fenestration, South African M. J. **24**:325-327, 1950.

The author reports an improvement one year postoperatively of 20 db. in Twin A and 18 db. in Twin B (identical twins).

Fraser, G. A.: Hearing After Fenestration, J. Laryng. & Otol. **67**:224, 1953.

A case is reported in which the hearing improvement was maintained for a period of three years after the complete severance of the membranous external semicircular canal.

Fuser, L., and Invernizzi, M.: Deafness, the Essential Factor in Van der Hoeve's Triad, Arch. ital. otol. **63**:365-370, 1952.

García Ibañez, L.: Are the Results of Fenestration Lasting? Am. soc. otorrinolaring. Andal uza, Cadiz **2**:303-314, 1950.

The varying results in 55 cases are discussed.

Garson, P.: Otosclerosis: A Closed Method of Fenestration, J. Laryng. & Otol. **66**:65-70, 1952.

The postaural approach is used, the incus (but this is not imperative) removed, but the other structures of the middle ear are left in situ, and no tympanomeatal flap is constructed. A free graft of conjunctiva is used to cover the fistula, and this is held in place by gold leaf and gauze. Until the eighth day the wound is left open but is then closed after removal of the dressing. The results in 35 cases indicate that convalescence was speedy. As an aid in obtaining a bloodless field, pentamethonium bromide was used to lower the blood pressure.

Gušic, B.: Results of Lempert's Fenestration Operation, Zbomik radova drug. kongr. otolaring. Jugoslav., pp. 207-218, 1951.

Instead of using Lempert's technique, the author performs a mastoidectomy by means of a chisel. Sixteen out of 20 cases operated upon showed improved hearing of from 20 to 30 db. in the areas most useful for speech. Two of three patients, although with unfavorable audiometric results, maintained that they were satisfied with the postoperative level of hearing. In the remaining three cases the fenestra closed before the end of the year. In one of these patients a second operation proved successful.

Hahlbrock, K.: Further Indication for the Fenestration Operation, Arch. Ohren- Nasen- u. Kehlkopfh. **161**:435-440, 1952.

The author discusses the problems one meets, particularly in elderly people in whom the neural deafness has progressed to a point where the hearing aid is ineffective mainly because so much amplification is necessary that it is not tolerated. In such cases the author claims that a fenestration operation, in selected cases, may enable the patient to employ less amplification from the hearing aid and thus help him in becoming rehabilitated.

Hall, I. S. (Edinburgh, Scotland): The Pathology of Otosclerosis, Fifth International Congress of Oto-Rhino-Laryngo-Broncho-Oesophagology, Amsterdam, June, 1953.

Bone specimens obtained from 25 consecutive fenestration operations were examined histologically and the incidence of otosclerosis lesions in the fenestrated area determined. A correlation was obtained between the clinical data and the pathological condition at the time of operation. It was possible to demonstrate various stages of the disease in this material and to reach some conclusions regarding the progress of the lesion of otosclerosis. Hyperostosis serves as a part of the otosclerosis process and can be shown to be an early development in the disease. The author discusses the blue mantles of Manasse in their relation to otosclerosis.

Heermann, H.: Failure in the After-Treatment of a Fenestration Operation (Loosening of a Sourdille Flap by Nose Blowing), H N O **3**:289-290, 1952.

Heermann, H.: Sterilization of the Grip of the Burr in Boiling Oil Before Fenestration Operations, H N O **4**:55-56, 1953.

Henner, R.: Psychosomatic Aspects of Surgical Treatment of Otosclerosis, Arch. Otolaryng. **52**:177-187, 1950.

House, H. P.: Long-Term Results of Fenestration Surgery, Ann. Otol. Rhin. & Laryng. **60**:1153-1163, 1951.

Eighty-eight out of 200 cases examined five years or more postoperatively showed that the best long-term results were obtained in those which were preoperatively favorable and had immediate favorable postoperative results. However, a sizable minority suffered a loss in hearing between the second and fifth years. Out of 1056 cases examined two years postoperatively 54% and of 88 five-year cases 34% showed "practical hearing." Nevertheless, two-thirds of the latter group said that they were pleased with the results.

Huggill, P. H.: An Irrigator for the Fenestration Operation, Brit. M. J. **2**: 441, 1952.

Jerger, J. F.: A New Test for Cochlear Reserve in the Selection of Patients for Fenestration Surgery, Ann. Otol. Rhin. & Laryng. **62**: 724-734, 1953.

The author uses recruitment as a useful tool in predicting the hearing results which may be expected from the fenestration operation. He observed and compared the difference limen at 10 db. and at 40 db. above threshold for the frequencies 250 to 4000. For example, the limens at these frequencies may differ by 1.2 db. at 250, 0.5 db. at 1000, and none at 4000 cycles.

The tests were standardized by experiment in 18 cases of perceptive deafness in which the etiology varied, and norms previously determined were used for comparison. In 55 instances the information obtained was compared with that obtained by the Shambaugh-Carhart bone curve method of prediction. It is believed that the difference-limen method may be of value, but it may not be used by the majority of otologists until it is more simplified and refined.

Kallay, F.: Fenestration in Non-Otosclerotic Prelabyrinthine Deafness, Magyar sebész. (Budapest) **4**: 305-310, 1951.

Plastic procedures on the external auditory canal with fenestration and the use of Thiersch flaps were done, with favorable results, in cases of bilateral congenital

stenosis, chronic residual adhesive process, and postunilateral mastoidectomy. The procedure may be carried out with one- or two-stage operations. The flap may be from the tympanomeatal epithelium, from the epithelized lining of the cavity, or from the matrix of a cholesteatoma.

Kettel, K.: Attempted Fenestration Operation in a Case of Absence of Lumen of Semicircular Canals, Arch. Otolaryng. **52:** 284-287, 1950.

Klotz, G.: Some Aspects of the Pathogenesis of Otosclerosis, Acta oto-laryng. **41:**204-212, 1592.

The author sets up a hypothesis that otosclerosis is caused by endolymphatic hypertension.

Krejci, F. I.: Statistical Studies on the Value of Ultrasonic Therapy in Diseases of the Ear, Wien. klin. Wchnschr. **63:**707-709, 1951.

Ultrasonic therapy was applied to the following conditions: otosclerosis, chronic adhesive processes, traumatic and other internal ear lesions, Ménière's syndrome, neuritis of the eighth nerve, syphilitic neuritis, vertigo after Day's operation, and tinnitus after operation on the labyrinth. There were no indications of any response to this treatment.

Lamp, C. B., Jr.: Reduction of Postfenestration Vertigo by Use of Isothermal Isotonic Irrigation Technic, Proc. Staff Meet., Mayo Clin. **27:**565-568, 1952.

Whereas isotonic fluids are isotonic for blood, they are not isotonic for the endolymph and perilymph. Osmotic pressures are for blood 0.994; endolymph 1.058; perilymph 1.046, and CSF 1.017. The author believes that by using fluids non-isotonic with the perilymph for irrigation during the fenestration operation postoperative endolymphatic hydrops is more likely to occur and that it results in a delayed hearing improvement. A solution isotonic with the perilymph may be obtained by placing in 1 liter of solution 9.94 gm. of sodium chloride and 6.093 gm. of sucrose (used at 37 C). By employing such fluid, the author obtained improvement, as shown by the threshold and the recruitment tests.

Langenbeck B.: New Methods in Fenestration Operations, with Observations in Postoperative Treatment, Ztschr. Laryng. Rhin. Otol. **31:**597-602, 1952.

With the patient under local anesthesia, and with the postauricular approach, the labyrinth is opened by using slender flat chisels with rounded edges as scrapers. The author reports one patient who obtained an additional improvement in hearing when the drum was screened off by a cotton pad after the operation. The author believes that this occurred because of the blocking-off of the sounds to the fenestra rotunda.

Lansberg, M. P.: Corticotropin (ACTH) and Fenestration, A. M. A. Arch. Otolaryng. **55:**662-665, 1952.

It was thought that corticotropin (ACTH) might be of some use in preventing postoperative wound reactions and labyrinthitis following the fenestration operation. In rabbits corticotropin inhibited wound reactions following skull trauma. In two patients the author obtained doubtful results. He states that high concentration must be used and that corticotropin might be even better locally, rather than intramuscularly. The author questions whether corticotropin should be withheld from patients undergoing the fenestration operation, pending proof of its efficacy on animals.

Lempert, J.: Otology: Its Present Status, J. Mt. Sinai Hosp. **19:**381-395, 1952.

The observations which led to the adoption of the intramarginal invagination of the flap are discussed, particularly in regard to securing adhesions to the lateral walls of the fenestra rim. The author believes that through the use of his method a very high percentage of fenestras will remain permanently open.

Maggio, E.: Treatment of Otosclerosis with Testosterone Associated with Alpha Tocopherol, Arch. ital. laring. **59:**188-190, 1951.

Maggio, E., and La Fianza, F.: The Urinary Excretion of Total 17-Ketosteroids in Otospongiosis, Arch. ital. laring. **60:** 371-380, 1952.

The total 17-ketosteroids were examined in patients with otosclerosis. They were found to be altered to some degree in 72% of the cases. The authors consider that this finding suggests that otosclerosis is the consequence of a hereditary familial heredomorphogenetic tendency of the susceptible ears to respond to some general neurohormonal disturbance.

Mathe, K. (Dresden, Germany): Prognosis and Treatment of Otosclerosis, Fifth International Congress of Oto-Rhino-Laryngo-Broncho-Oesophagology, Amsterdam, June, 1953.

The author maintains that prognosis of otosclerosis is difficult because of the fact that it is impossible to evaluate with certainty the true cochlea status before operation. After operation there may be either improvement or deterioration in the bone conduction whether or not a labyrinthitis has been occasioned. With the Carhart formula the prognosis can be better predicted. The author ascribes the deterioration in bone conduction to a greater sensitivity of the endolymphatic apparatus, to thickening of the endosteum, and to atrophy of the semicircular canal. He describes a case which was a revision of a fenestra which had been closed by a 0.5 cm. thick Sourdille graft. He recommends a transplantation with the Thiersch graft and states that this is always successful.

Mayoux, A. R., and Martin, H.: Aural Functional Synergism, J. franc. oto-rhino-laryng. **1:**2-12, 1952.

Both in otosclerosis and chronic otitis media, the audiograms are regularly similar bilaterally and the bone-conduction audiograms are almost always identical on the two sides. The authors confirm this fact by showing that after fenestration for otosclerosis and after catheterization of the Eustachian tube for chronic nonsuppurative otitis media there followed an improvement not only in the treated but also in the untreated ear. Unsuccessful operations produced unfavorable changes in air conduction and bone conduction in both the treated and the untreated ears. The authors are led to the conclusion that a certain inhibitory reflex exists, which reflex extends from the ear first affected to the contralateral ear, then impairing the function of this ear. They argue that this is one reason why one should do a fenestration operation first on the ear affected by the otosclerosis. In cases in which the audiograms are bilaterally similar, this is of special importance because the loss of hearing on the side first affected is determined by the lesion, while the contralateral loss is mainly determined by the reflex inhibitions originating from the ear first affected. Operations will be effective only when they are performed

on the primarily affected ear and not on the secondarily affected ear. The phenomena described are attributed to central neural mechanisms and are functionally synergistic in nature, analogous to the well-known vestibular functional synergistic mechanisms.

Mayoux, R., and Martin, H.: Secondary Otosclerosis, J. méd. Lyon **34:** 719-724, 1953.

Tubotympanic "catarrh" may in some cases resemble in its symptoms otosclerosis. This the authors call "secondary otosclerosis" and believe that it may be helped by injections of hypertonic saline solutions. They believe that these solutions may be used as an aid in diagnosis.

McConnell, F., and Carhart, R.: Influence of Fenestration Surgery on Bone Conduction Measurements, Laryngoscope **62:** 1267-1292, 1952.

In an analysis of the authors' material there appeared to be an actual change in bone-conduction thresholds in the frequency range from 1000 to 2000 cps. This, the authors believe, was probably due to mechanical changes in the middle-ear conduction mechanism, but further research is necessary to prove or disprove this contention. There were considerable variations between patients.

McKenzie, W.: The Fenestration Operation: Some Difficulties, J. Laryng. & Otol. **65:** 756-772, 1951.

The author discusses his experiences in the performance of 78 fenestration operations, particularly concerning the problems arising preoperatively and postoperatively.

McKenzie, W.: The Gain in Hearing After the Fenestration Operation, and Its Influence upon the Surgeon's Choice of Case, J. Laryng & Otol. **66:**211-225, 1952.

After a satisfactory fenestration operation the hearing loss will be in the neighborhood of 25 db. for the frequencies most important for speech. This approximates the loss to be expected whenever the ossicles are removed and before adhesive processes increase the impedance. If the loss for the speech frequencies is less than 60 db. preoperatively, this same level of hearing should be obtained postoperatively. In other words, it shows that a mere decibel gain alone is misleading. If the loss of hearing is less than 36 db., the operation is not justifiable. An unusual loss with one ear showing less than 30 db. and the other more than 30 db. also usually contraindicates doing the fenestration operation. The best results are usually obtainable when the hearing in both ears lies between 30 and 60 db. If the fenestration operation has been successful in one ear, this would influence one in operating on the other ear, but with less than a 30 db. loss it will not make much difference whether the second ear is operated upon or not. If the loss is more than 30 db., operation may be advisable, but only in case the opposite ear will tolerate wearing a hearing aid. It must be kept in mind that the second operative procedure may fail, in which case a hearing aid will be necessary.

Meurman, Y., and Savolainen, T.: Bacteriological Examination and Determination of Bacterial Resistance in Aural Suppuration Following Fenestration, Acta oto-laryng., Supp. 100, pp. 26-32, 1951.

The predominant bacteria in the primary cultures made from 63 suppurative fenestration cavities were Staphylococcus aureus, in 19 cases; Pseudomonas aeruginosa, in 21 cases, and Corynebacterium pseudodiphtheriticum, in 7 cases. One hundred healthy external auditory canals, with the nose, pharynx, and fauces, were examined to find possible sources of infection from these regions of patients just before the fenestration operation. No P. aeruginosa was found, and it is therefore inferred that the infection gained entrance postoperatively from the environment. Tests were made to determine the resistance of bacteria to sulfathiazole and antibiotics. Treatment with the substances gave good results in many cases.

Miskolczy-Fodor, F., and Jantsek, G.: Investigations into the Pathways of Sound Conduction and the Causes of Improved Hearing in Otosclerosis: Sound-Damping Experiments Made Before Operation and After Fenestration, Acta med. Acad. Hung. **3**:385-421, 1952.

The authors blocked the different sound pathways with cotton wool, either dry, wet, or impregnated with petrolatum (Vaseline) or paraffin, and tested the hearing both before and after this procedure. They conclude that biological causes of the changes in hearing are (1) abnormal pathways followed by the sound vibrations, (2) changes in impedance, and (3) changes in the resonance frequency of the external auditory meatus.

They concluded that in cases of ankylosis of the stapes the sound vibrations passed more readily by way of the external ear and the drum membrane unless the bone-conduction threshold was raised 50 to 60 db. higher than the air-conduction threshold, in which case air-borne sounds by bone conduction are heard. Following the fenestration operation, some vibrations reached the labyrinth through the fistula, but neither before nor after fenestration do the sound vibrations reach the labyrinthine fluids by way of the round window. The drum is a passive protector for the round window and no longer a conduction mechanism following the fenestration operation. The fenestration cavity has a resonance frequency lower than that of a normal external auditory canal (1500 to 2000 cps instead of approximately 2500, respectively). This brings it into the region of the frequencies very important for speech. For this reason intelligibility is more improved than would appear from the pure-tone audiogram. The postoperative hearing improvement is due both to the improved air conduction and to an improved bone conduction, explainable only by a change in the intralabyrinthine factors.

Monkhouse, J. P.: The Diagnosis and Treatment of Otosclerosis, Arch. Middsex Hosp. **2:** 215-227, 1952.

Nager, F. R., and Ruedi, L.: Histological Examination of Bone Chips Obtained by Fenestration for Otosclerosis, Acta oto-laryng. **39:** 300-313, 1951.

In 62 fenestration operations in which the bone chips were investigated, 8 were suspected at the time of operation of harboring an otosclerosis lesion in the region of the fenestration. In these eight cases otosclerotic changes were

found in the bone chips investigation. This is a higher incidence than formerly suspected. An otosclerotic lesion in the semicircular canal did not appear to interfere with postoperative healing of the fenestration operation. In five of the eight cases blue mantles (Manasse) were revealed, and in three of the eight, active foci of otosclerosis.

Nylen, B.: Histologic Study of an Operated On Case of Otosclerosis Three Years After Fenestration, Upsala läkaref. förh. **56:** 101-107, 1951.

A patient of Holmgren's on whom a fenestration was done in 1945, and a secondary operation subsequently four and a half months later, died in 1948. Autopsy material revealed a diffuse otosclerotic lesion with bilateral partial ankylosis of the stapes. The fistula in the lateral semicircular canal was obliterated and overgrown with osteoid, nonsclerotic bone. There was a focus of otosclerosis near the fistula. Investigations of Nager's specimens led the author to the opinion that foci of otosclerosis occur more frequently in the areas choosen for Lempert's fenestration operation, i. e., the dome of the vestibule and ampulla of the horizontal semicircular canal, than in the bone of the semicircular canal itself. It is suggested that the degree of sclerosis of the bone operated upon may influence the prognosis in fistularization operations.

Nylen, C. O., and Nylen, B.: On the Genesis of Otosclerosis, J. Laryng. & Otol. **56:** 55-64, 1952.

The authors call attention to the fact that owing to the difficulties involved and concentration on the surgical measures there have been of late years but few papers dealing with the genetic factors in otosclerosis. They particularly comment on Guild's statistics as to the incidence of otosclerosis but are inclined to favor Fowler Sr.'s figures, namely, that if we include the undected lesions the incidence in the white race would be near 10% for the males and 20% for the females. However, they are inclined to the opinion that the ratio between the sexes would not be as great as this. The research has been concentrated on the circulation of the blood in the bony capsule of the labyrinth, particularly as to its vascularization. They also believe that one or more other factors are involved in the genesis of otosclerosis, particularly some metabolic disorder due to imbalance of the internal secretions. Dysfunction of the parathyroid glands is favored as a primary or secondary cause influencing metabolism of the enzymes and mineral salts.

O'Brien, D., and Cole, W. H. J.: The Use of Controlled Hypotension Combined with the Local Use of Adrenalin as an Aid to the Fenestration Operation, M. J. Australia **1:** 300, 1953.

Ogilvie, R. F., and Hall, I. S.: Observations on the Pathology of Otosclerosis, J. Laryng. & Otol. **67:** 497-535, 1953.

The authors state that "the material obtained from the horizontal semicircular canal of otosclerotic subjects treated by fenestration is valuable in that: (1) it is unlimited as regards supply; (2) it is obtained from living individuals for the most part in the younger age groups and thus presumably in the earlier stages of the disease; (3) it may be correlated in respect to any pathology with the clinical features and post-operative progress of the patient." The material

examined consisted of the bony roof of the ampullary end of the horizontal semicircular canal. The 125 fenestrations were fairly consecutive and therefore may be thus considered unselected cases of otosclerosis. The controls were taken from 33 subjects dying from varying diseases other than otosclerosis. There was no evidence of damage present in the control group, but 13% of the otosclerosis group revealed signs of disease. In one case reoperated on after an interval of 27 months there appeared to be bilateral damage in the fenestrated areas. In the 10 females, aged 28 to 46, and the 6 males, aged 24 to 54, the damage occurred in diffuse and local forms and varied in degree of activity. The diffuse and local diseases occurred separately in seven specimens each, and in combination in three specimens. The diffuse damage involved absorption and deposition of the bone by osteoclastic and osteoblastic activity, respectively, and led to abnormal cancellous process, mosaic, and fairly normal architecture. The mature bone is acidophile, normally cellular, and laminated, whereas the immature bone is excessively cellular and web bone. The so-called "blue mantles," because of their position, mode of formation, structure, fate, and occurrence with the diffuse disease, and their absence in the control material, are regarded as a focal manifestation of the damage. Whether the disease is active, quiescent, or healed, the local damage may be classified as quiescent or healing. In both the diffuse and local disorders the various stages are accompanied in one or more instances by hyperostosis and structurally resemble chronic inflammation or dystrophy of the bone. They may therefore be logically attributed to either infective or endocrinological factors acting separately or in combination.

Opheim, O.: Acute Cryptogenetic Total Deafness Fenestration, Acta oto-laryng., Supp. 95, pp. 58-69, 1950.

Passow, H., Jr.: The Improvement in Hearing in the Unoperated On Ear in Fenestration, Ztschr. Laryng. Rhin. Otol. **30:** 441-445, 1951.

After fenestration in many cases there was an improvement in the hearing in the ear not operated on which lasted from 6 to 12 months. Further investigation of this unexplained phenomenon is urged.

Patroni, A.: Otosclerosis and Endocrine Balance, Oto-rino-laring. ital. **20:**126-129, 1952.

Popper, O.: Transtympanic Technic in Surgical Otology: Transtympanic Postscripts, Arch. Otolaryng. **51:**356-370, 1950.

Pruvot, M.: Round Window and Conservative Fenestration, Acta oto-laryng. **43:** 601-608, 1953.

Rambo, J. H. T.: Effect of Cortisone on Osteogenesis Following Fenestration in the Monkey: An Experimental Study, A. M. A. Arch. Otolaryng. **55:** 554-558, 1952.

Ten milligrams of cortisone was administered intramuscularly daily over a period of 25 days to two Rhesus monkeys previously fenestrated. Two hundred seventy-eight and 280 days, respectively, following the operation histological examination showed that in both monkeys the fenestras had closed by new bone formation. The author concluded that cortisone had no inhibitory effect on osteogenesis.

Ramon Mozota Sagardia, J.: Inhibitory Treatment of the Development of Fibrous and Bony Tissue After Fenestration, Clín. y lab. **52:** 283-288, 1951.

Immediately after fenestration operations in five cases 50 mg. of cortisone was instilled into the mastoid cavity and over the fenestra. This was repeated on the 5th, 10th, and the 15th day postoperatively. Excessive granulation appeared to be controlled and healing was therefore more satisfactory than when the cortisone was not used in this way. It is thought probable that the probability of closure was lessened. In one instance transitory edema with other symptoms of water retention occurred, but by the use of potassium chloride these disappeared.

Ramon Mozota Sargardia, J.: Penicillin Therapy in Fenestration, Clín. y lab. **55:** 127-129, 1953.

Ramon Mozota Sagardia, J.: Hypersensitivity of Fenestrated Patients to Streptomycin, Clín. y lab. **55:** 188-192, 1953.

Ramon Mozota Sagardia, J.: Prevention and Treatment of Serous Labyrinthitis and Labyrinthine Hydrops in Fenestrated Patients, Clin. y lab. **55:** 353-356, 1953.

With the aid of a local anesthetic and the use of a sponge instead of gauze, satisfactory hemostasis may be obtained, and also perfect aseptic technique and the avoidance of fibrosis. Suitable antihistamine treatment is stressed.

Ranke, O. F.: Bone Conduction After Fenestration Operation, Arch. Ohren- Nasen- u. Kehlkopfh. **161:** 534-536, 1952.

The author discusses von Békésy's theory of bone conduction. He contends that the increase in bone conduction in otosclerosis is explainable by the fact that a bony closure of the oval window produces by back-pressure a larger excursion or a larger difference in pressure on the round-window membrane. However, he points out that this theory does not stand up because it does not explain the increased bone conduction found following the fenestration operation, in which case an escape exit has been created from the scala vestibuli. The author explains the phenomenon by experimental methods.

Rebagliatti, H., and Santoro, A.: Two Variations in the Fenestration Technic, An. oto-rino-laring. Uruguay **23:** 11, 1953.

The authors make two modifications in the fenestration technique: 1. They limit the extent of the operation to the attic, which they enlarge by means of a gouge and mallet, and the incus is removed by a hook. 2. The horizontal canal is opened by a curette rasp.

Riskaer, N.: Response of Otosclerosis and Adhesive Otitis to Treatment with ACTH, A. M. A. Arch. Otolaryng. **55:** 342-349, 1952.

Twelve patients with otosclerosis, 2 with middle-ear adhesive deafness, and one with congenital aplasia suffered the fenestration operation and were given twenty 30-mg. doses of corticotropin (ACTH) intramuscularly four times a day for eight days, some immediately after the operation and some one week postoperatively. Twelve nonfenestration patients were treated similarly with

corticotropin as controls. The treatment appeared to have no effect on long-standing otosclerosis in ears not operated on or in adhesive otitis. However, in one patient who had had impaired hearing for only three months an improvement was obtained. If this was a beginning otosclerosis, it is suggested that incipient cases might respond favorably to corticotropin treatment. No impressive results were obtained in the patients in which the fenestra closed or in those in which there was a postoperative loss of hearing. In spite of body-fluid retention in the majority of patients, the treatment had no unpleasant effects. There was no increase in the deafness or in the vestibular reactions usually observed.

Rius, M.: Treatment of Postoperative Atresia of the External Auditory Canal by Lempert's Method, An. oto-rino-laring. Uruguay **23:** 15-17, 1953.

Roddier, H. (Paris, France): False Otosclerosis, Fifth International Congress of Oto-Rhino-Laryngo-Broncho-Oesophagology, Amsterdam, June, 1953.

The mechanism of this form of deafness appears to consist of vasomotor reactions as a result of hormone deficiencies; particularly it includes deafness occurring following some disease and, especially, uteral ovarian operations and the menopause. Although false otosclerosis has a considerable number of clinical symptoms in common with otosclerosis deafness, a differential diagnosis may be made and a considerable improvement in hearing obtained by rational treatment. The article is illustrated by audiograms.

Rollin, H.: A Review of the Author's Experience with the Lempert Technique over Two and a Half Years, Ztschr. Hals- Nasen- u. Ohrenh. **3:** 4-6, 1952.

Considering the age group operated upon, the author is of the opinion that his over-all results are favorable.

Rosen, S.: Fenestration by Cold Fracture Method: Preliminary Report of Improved Technics, Arch. Otolaryng. **52:** 618-621, 1950.

The author believes that it is better to separate the tympanomeatal flap completely before any bone work is done, as this avoids the accumulation of bony spicules, which may become buried in the flap during its separation coincidental to the removal of the bony meatal wall.

Rosen, S.: Palpation of Stapes for Fixation: Preliminary Procedure to Determine Suitability in Otosclerosis, A. M. A. Arch. Otolaryng. **56:** 610-615, 1952.

The author records six cases in which he describes his technique for reflecting the skin of the bony canal upward with the inferior portion of the tympanic membrane. This technique allows a better view of the region of the stapes and oval window to test the degree of stapes fixation, to mobilize it in certain conditions, and as an aid to diagnosis in some cases.

Ruedi, L.: On the Surgical Treatment of Deafness, Irish J. M. Sc. **5:** 263-273, 1952.

The technique is in two stages: The first carried out through an endaural incision, with a skin graft; the second, two months later and after the cavity is

dry, for the fenestration proper by retroaural incision. A large operative cavity is thus made available to facilitate the implantation of the skin graft and the use of the microscope in the second stage. Because postoperative traumatic labyrinthitis depends largely on the inflammatory reactions in the flap covering the fistula, the method reduces to a minimum trauma from this source. From the epidermis which covers the inner wall of the cavity a small skin flap is formed to cover the area above the horizontal semicircular canal. The fenestration is made over the exposed dome and is closed by the skin flap. The flap then falls back into its former bed and attaches firmly to the wound margins of the epidermis which hugs the cavity. After five days the paraffin gauze which was used to keep the flap in place is removed. The flap normally is healed completely at this time, and the ear, being dry, needs no more dressings. Advantages of a two-stage operation are set forth as follows: "(1) The second operation is limited to the formation of a small skin flap within the prepared and epithelialized cavity, and to the creation of the labyrinthine window. (2) The flap is made out of skin already thinned and tightly adherent to the semicircular canal. (3) The inner surface of the flap has acquired periosteal smoothness. (4) When covering the fenestra, the flap is placed into a fitting groove, where within five days it unites with the scar margins of the already existing intact epidermis without any inflammatory reaction. Secondary closures of the fistula seem to occur less often with the diminution of postoperative serous labyrinthitis."

Sade, N.: Results of Three Years' Fenestration Operation at the Assutah Hospital in Tel-Aviv, Oto-laryng. israel. **2: 23**, 1952.

Seiferth, L. B., and Jatho, K.: On the Closure of the Labyrinthine Fistula with Amnion in Fenestration Operation: With a Contribution Concerning Post-Operative Irritation of the Labyrinth and the Problem of the Acoustic Function of the Round Fenestra and the Labyrinthine Fistula, H N O **3:** 198-201, 1952.

The authors use amnion instead of grafts for covering the fistula. Good results were obtained in seven instances, and far less irritation of the labyrinth resulted. Amnionic tissue, being very thin, is transformed to fibrous tissue and is capable of submitting vibrations with more facility that the thicker cutaneous flap used according to Sourdille's method.

Shambaugh, G. E., Jr.: Correlation of the Predicted with the Actual Result of Fenestration in 164 Consecutive Cases, Laryngoscope **62:** 461-474, 1952.

The bone-conduction curve provides a measure for estimating cochlear reserve, provided that one uses strict audiometric techniques and makes a correction for the "Carhart notch." After successful fenestration operation about 25 db. is the average amount of unrestored loss from the conduction deafness. The fenestrated ear also lacks the impedance-matching mechanism of a normal middle ear. The author makes three audiograms and averages them and makes a correction for the "Carhart notch." The predicted result is on the average about 25 db. below the bone-conduction curve for the speech frequencies. One hundred sixty-four cases were studied, and it is hoped that the formula proposed may be useful for predicting results. Individual variations will, of course, be considerable.

Shambaugh, G. E., Jr.: Prognosis in Fenestration Surgery, West. J. Surg. **60:** 533-536, 1952.

Conclusions: "The otologist . . . may give [a] patient a fairly definite and reliable prognosis of what he may expect from fenestration as compared with a hearing aid, by means of careful air and bone audiometry, supplemented by controlled speech and discrimination tests.

"The probable results of surgery can be estimated with fair accuracy as 15 decibels below average bone readings for the speech frequencies, and this predicted hearing result can be compared with the efficiency of the patient's hearing aid as measured by objective tests. With this information, the patient with otosclerosis should be able to reach a wise and intelligent choice between a hearing aid or surgery."

Shambaugh, G. E., Jr.: Causes of Failure in Surgical Fenestration: A Follow-Up of 3000 Consecutive Cases, J. Internat. Coll. Surgeons **19:** 104-109, 1953.

The author enumerates the operative details which he considers to be important. Out of 3091 cases, 416 failed to reach or maintain an improvement of 10 db. or more. Serous labyrinthitis was the commonest cause of initial failure. The next most important cause of failure was in the selection of patients. Technical operative errors accounted for six failures. Later failures arose from bony closure, degeneration of the cochlear nerve, and some unknown causes. He believes that under the last category labyrinthine hydrops might be a factor. The author also mentions certain minor accidents and some serious complications elsewhere in the body.

Shea, M. B., and Tanton, B.W.: Anaesthesia for Fenestration, Canad. M. A. J. **66:** 154-156, 1952.

The authors review the present techniques in anesthesia and fenestration.

Siirala, U.: Contribution to the Technique of Fenestration, Acta oto-laryng. **42:** 275-279, 1952.

Thiersch grafts were used recovering the fenestra, and the original skin flap was utilized to seal off the tympanum and isolate it from the mastoid cells. The author believes that the results obtained by this method are encouraging but warns that the operative cavity must be kept small.

Simson Hall, I.: A New Approach to the Study of the Pathology of Otosclerosis, Acta oto-laryng., Supp. 100, pp. 164-168, 1951.

"Living bone" is obtained from the labyrinth of patients operated on by fenestration and from controls obtained from postmortem specimens. In the former, changes may be watched for years. Specimens obtained in the early age groups are presumed to be in the early stages of otosclerosis, while specimens obtained as soon as possible after death may be in either late or early stages of otosclerosis. The author uses the specimen taken from the roof of the ampullary portion of the horizontal canal and one from the antefenestral region so that they may be compared. Conclusions: "(1) Since the changes seem to centre round the vascular spaces, there would appear to be support for the vascular

theory of the aetiology of the disease, and (2) since there appears to be evidence that otosclerosis can be healed or become completely quiescent, there would seem to be reasonable grounds for expecting the retention of regained hearing in a fenestrated patient for many years at least, provided osteogenesis has not produced reclosure of the fenestra." If the author's judgment is correct, the fenestration operation might be not only a palliative but a measure for arresting the progressive deafness.

Solero, C.: Verbal Audiometry of Patients Who Have Undergone a Fenestration Operation, Minerva otorinolaring. **1:**168-174, 1951.

Speech audiometry was used (1) to evaluate the indications for operation and to prognosticate ultimate improvement therefrom; (2) to measure the subjective improvements in correspondence with the speech audiometry data; (3) to measure the postoperative results graphically; (4) to aid in following the course in postoperative serous labyrinthitis. The author reached the conclusion that speech audiometry is more complicated than pure-tone audiometry and is not sufficiently advantageous to justify its preference for these techniques but that it is useful in conjunction with the other clinical methods of interpretation.

Solero, C.: Studies on One Hundred Cases of Fenestration of the Labyrinth, Valsalva **29:** 240-249, 1953.

Nearly all of Solero's cases suffered from otosclerotic deafness. Good results were obtained (i. e., a 30 db. or less hearing loss for the speech-frequency range) in 61.90% of the cases. Stress is laid on operative technique, especially use of optical magnification up to 8 to 10 times, and good endochondralization.

Stubensey, L. A.: A Discussion of Anesthetic Procedures for the Fenestration Operation (2375 Cases), Anesthesiology **14:** 303-310, 1953.

This large amount of material must be read in detail. It can not be adequately abstracted.

Thullen, A.: The Influence of Complications Affecting the Tubes and the Middle Ear on the Hearing After Fenestration, Arch. Ohren- Nasen- u. Kehlkopfh. **162:** 126-134, 1952.

Disappointing results following the fenestration operation, in addition to traumatic or inflammatory reactions in the fenestra and inner ear, may be caused by diseases of the Eustachian tube. This occurs in patients operated on for middle-ear adhesive processes. Perforations of the tympanic membrane diminish the hearing; satisfactory functional improvement may be obtained by closing the opening in the drum. The author determined that the tension, form, and size of the tympanic membrane influence the acuity of hearing. In some of his patients cotton wool inserted in front of the drum brought about improvement, whereas if placed on the newly created fenestra, it always led to a deterioration of hearing. The author cites this circumstance as seeming to show that the sound vibrations reach the inner ear by way of the fistula, and not through the round-window membrane.

Valerio, M.: Human Labyrinth and Endocranial Hypertension, Clin. otorinolaring. **5:** 256-270, 1953.

Van Den Branden, H.: Contribution to the Study of Therapy in Otosclerosis, Bull. Acad. roy. méd. Belgique **16**:352-374, 1951.

Varga, G.: Modified Method of Fenestration in Otosclerosis to Prevent Closing of the Fistula, Acta med. Budapest **2**: 311-317, 1951.

The author constructs what he terms a "dual-purpose" kind of window in the otic capsule. In the narrow canal portion the endosteal cover is retained, and in the dome portion the fenestrum is uncovered in the usual way. In the eight cases thus far operated upon neither histological nor observational criteria seem adequate to accomplish the above.

Vetter, H.: Histological Findings of a Patient Forty Months After Successful Fenestration, Acta oto-laryng., Supp. 103, pp. 1-27, 1952.

The author states that a method of operating has not yet been standardized, as even the most experienced operators keep altering their techniques. He believes that further progress in the microsurgery of the ear lies in histological investigations of the temporal bones of operated on patients as well as in clinical observation and experiment on animals. He details the autopsy findings in a patient upon whom he had operated 40 months previous to her death from cancer. In both temporal bones typical otosclerosis foci were found in the neighborhood of the oval window. Neither at the edges of the fenestra nor around the bony chips in the perilymphatic space was any secondary ossification visible. This accounts for the excellent result obtained.

Vyslonzil, E.: A Steroscopic Microscope for the Fenestration Operation, Mikroskopie **8**:15-22, 1953.

The stereoscopic microscope enlarges the image 10 times. The picture is upright, and the working distance is 175 mm. Two lamps, one of which is movable, are used to illuminate the operative field. The apparatus is fixed to the operative table, which is movable without necessitating any readjustment of the microscope. For operations under controlled hypotension this feature is important.

Vyslonzil, E.: Controlled Hypotension in Fenestration Operations, Wien. klin. Wchnschr. **64**:772-775, 1953.

The author concludes that controlled hypotension produces an optical visualization of the field, shortens the time of operation, and increases its safety. Also, postoperatively practically no vertigo occurs, and the period of temporary loss of hearing is shortened. The author points out the danger involved in this procedure and discusses its modus operandi. He urges that only those who are familiar with this method of anesthesia should use it.

Wust, H.: Vestibular Reactions After Fenestration, Arch. Ohren- Nasen- u. Kehlkopfh. **159**:260-265, 1952.

The nystagmus movements following measured variations in pneumatic pressure in the external auditory canal were electrically recorded in eight cases with open fenestras. A 15 to 20 mm. Hg increase in pressure regularly resulted in nystagmus to the same side; the pressure, though then remaining constant, resulted in a generally diminishing nystagmus with time. After the pressure returned to normal

the nystagmus was directed to the opposite side. A primary decrease instead of an increase in pneumatic pressure reversed these phenomena. It is believed that ampullopetal flow results in a stronger reaction than an ampullopetal flow of endolymphs, in accordance with Ewald's law.

Zangemeister, H. E.; Rollin, H., and Kietz, H.: Labyrinthine Fenestration Opertions and the Possibilities of Their Further Development, Acta oto-laryng. **39:**427-441, 1951.

The intracranial approach is described and 16 cases recorded, in 7 of which there was a lasting improvement. The superior semicircular canal was opened and the fenestra covered by the dura. By this technique the middle ear is short circuited. The difficulties entailed by the intracranial procedure make further experience necessary before the operation can be accepted.

Zangemeister, H. E.: The Improvement of Hearing in the Operated On Ear After Fenestration, Arch. Ohren- Nasen- u. Kehlkopfh. **161:**537-539, 1952.

The author's observations were made on a patient subjected to fenestration by the endocranial route. The hearing improved after paracentesis on both the operated on and the unoperated on ears, which was done to facilitate the passage of sound through the round window. It was believed that the improved hearing in the unoperated on ear was due to an error in the audiometric testing and was brought about in the operated on ear by the improved bone conduction.

Zollner, F.: Plastic Operations on the Labyrinthine Windows, Arch. Ohren-Nasen- u. Kehlkopfh. **161:**414-422, 1952.

With the use of the operating microscope or loupe the stapes is mobilized and the niche of the round window cleared of obstruction. The drum membrane is preserved, and the fistula is covered by conjunctival graft. When there is profound deafness following radical mastoid operations, it is due to the fact that the vibrations activate both labyrinthine windows with about equal intensity and therefore produce no pressure differences. If both of the windows are mobile, better hearing may be achieved by using a prosthesis, i. e., a small pellet of cotton wool soaked in oil, placed against one of the window membranes, preferably the round window membrane. The author recommends the use of an artificial tympanic drum membrane in cases in which the Eustachian tube is patent. He employs a pedicle of skin taken from back of the ear and by a special technique places this graft over the tympanum. In this way he creates a new closed middle-ear cavity. He achieved marked hearing improvement in the three cases recorded.

Clinical Notes, New Instruments and Techniques

AN UNUSUAL FOREIGN BODY (SANDBUR) IN THE PYRIFORM SINUS

BURNETT SCHAFF, M.D., Coral Gables, Fla.

Anyone who has walked through the fields is familiar with sandburs, and knows how painful they can be when they contact the exposed extremities. This is a report of a man who accidentally swallowed two sandburs.

The patient came to the hospital one evening complaining of a sharp pain in the left side of his neck. The pain began while he and a friend were drinking coffee. Since the pain started suddenly and was localized to a small area, the two men thought that a sliver of glass had been swallowed. They became alarmed and rushed to the hospital. On the way over, the patient expectorated a profuse amount of blood-tinged sputum and noted that he was comfortable only if he kept his neck rigidly flexed to the left.

The pharynx was anesthetized, and a short esophageal speculum was introduced. Two sandburs (Figure) were seen embedded in the left pyriform sinus. They were removed without difficulty, and with immediate relief of symptoms. Small superficial ulcers were present where the points had penetrated the mucosa. The postoperative course was uneventful.

The sandburs after their removal.

Levin,[1] practicing in this area, has also removed these "stickers" from the larynx. Apparently another item must be added to the long list of objects that are accidentally inhaled or swallowed.

From the Department of Surgery, Veterans Administration Hospital.

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1. Levin, N. M.: Foreign Bodies in the Larynx, Bronchi and Esophagus, J. Florida M. A. **38**:611-618 (March) 1952.

PRINCIPLES AND MECHANICS OF SURGERY OF THE BONY NASAL VAULT

HARRY NEIVERT, M.D., D.Sc. (Med.), New York

It should be the endeavor of every surgeon to perfect his technique so that each step of an operation is done simply, efficiently, and purposefully. In other words, every move should produce a definitely planned result. There should be no "puttering," no hesitation, no useless motions. And yet, he should not get into the habit, as many have, of doing a stereotyped operation. Each case calls for individual study.

Before a surgeon begins an operation, he should see that he has the proper instruments ready and that all cutting edges are sharp. For many years I have given demonstrations on the care of instruments, and I have found that anyone who learns to use an instrument can learn to sharpen it. Curettes, chisels, knives, and scissors can be made shipshape in a few minutes (Fig. 1*A*, *B*, *C*, and *D*).

As I watched other men work and especially during my own operating, I encountered many mechanical problems which I endeavored to solve. I was particularly annoyed by instruments falling off the patient's chest or off the table. I therefore made a set of racks: one to pin on the patient's chest and the other to keep the instruments on the table in proper order (Fig. 2).

To remove blood and bone debris from the operative field, suction appears to be quick, clean, and most economical. The operating room does not have to be strewn with bloody gauze and swabs. Our suction tube is so constructed that once anything passes through the opening, there can be no blockage. This is accomplished by simply inverting the lip of the opening so that its diameter is less than the diameter of the tube. It is important that the tip be held slightly beyond any bleeding point, so that clotting be not interfered with.

To expose the nasal vestibule in order to make the primary incisions, I found most men were using a nasal speculum, a rake retractor, or a two-prong retractor. None of these appealed to me from a mechanical standpoint. I was trained in making an incision to keep the soft tissues as tense as possible in order to get a clean straight line. This I accomplished by making a closed-end retractor as a companion to the two-prong. To both of these I added, at the opposite end, the curved hook for exposing and cutting the lower lateral cartilages. This also serves as a single blunt-point retractor. It is important that this curved hook be made of two parallel wires with a minute space separating them, thus permitting the cutting edge of the knife to partly slip in between them. I use the No. 15 blade for all cutting. I see no necessity for the double-edge Joseph knife (Fig. 3).

The periosteum is elevated with a double-end elevator, as follows. I begin by making an incision in the periosteum on the patient's left just above the edge of the nasal bone with the sharp lip of the shorter end. Then the elevator sweeps laterally and medially to elevate a complete hood of periosteum and subcutaneous tissue and skin. I do not jab upward, which tears the periosteum into shreds. I then reverse the instrument and sweep over the dorsum with its compound curve to partially elevate the opposite side and come down over the cartilaginous vault with the semisharp section. The opposite side is then readily elevated with the short end. This method prevents shreds from bunching up or from dipping down between the separated nasal bones. The replaceable button-end knife completes the separation of soft tissues to the nasal spine, the columella being pulled downward by a right-angled mouse-tooth forceps, which has exceptional grasping power (Figs. 4 and 5).

I am now ready to discuss the actual bone work. In removing a hump, always remove less than you anticipate. Remember that in most cases the bony vault will retract while the cartilaginous vault remains at the projection you give it. After you have made a straight dorsum, that is, have lined up the bony and cartilaginous elements, take a little extra off the cartilage. Some men like to use saws, others chisels. If certain principles are kept in mind, the results should be the same. Personally, I use the saw for large humps and chisels for small ones. For easy portability, I have the equivalent of four saws in one handle (Fig. 6).

I have long been interested in overcoming certain deficiencies in our teaching of the surgery of the

Presented before the American Otorhinologic Society for Plastic Surgery, New York, Sept. 19, 1954.

Attending Surgeon, Veterans Administration Hospital, Bronx, N. Y., and Manhattan Eye, Ear and Throat Hospital. Assisted by Anthony Fragola, M.D., Senior Resident, Veterans Administration Hospital, Bronx, N. Y.

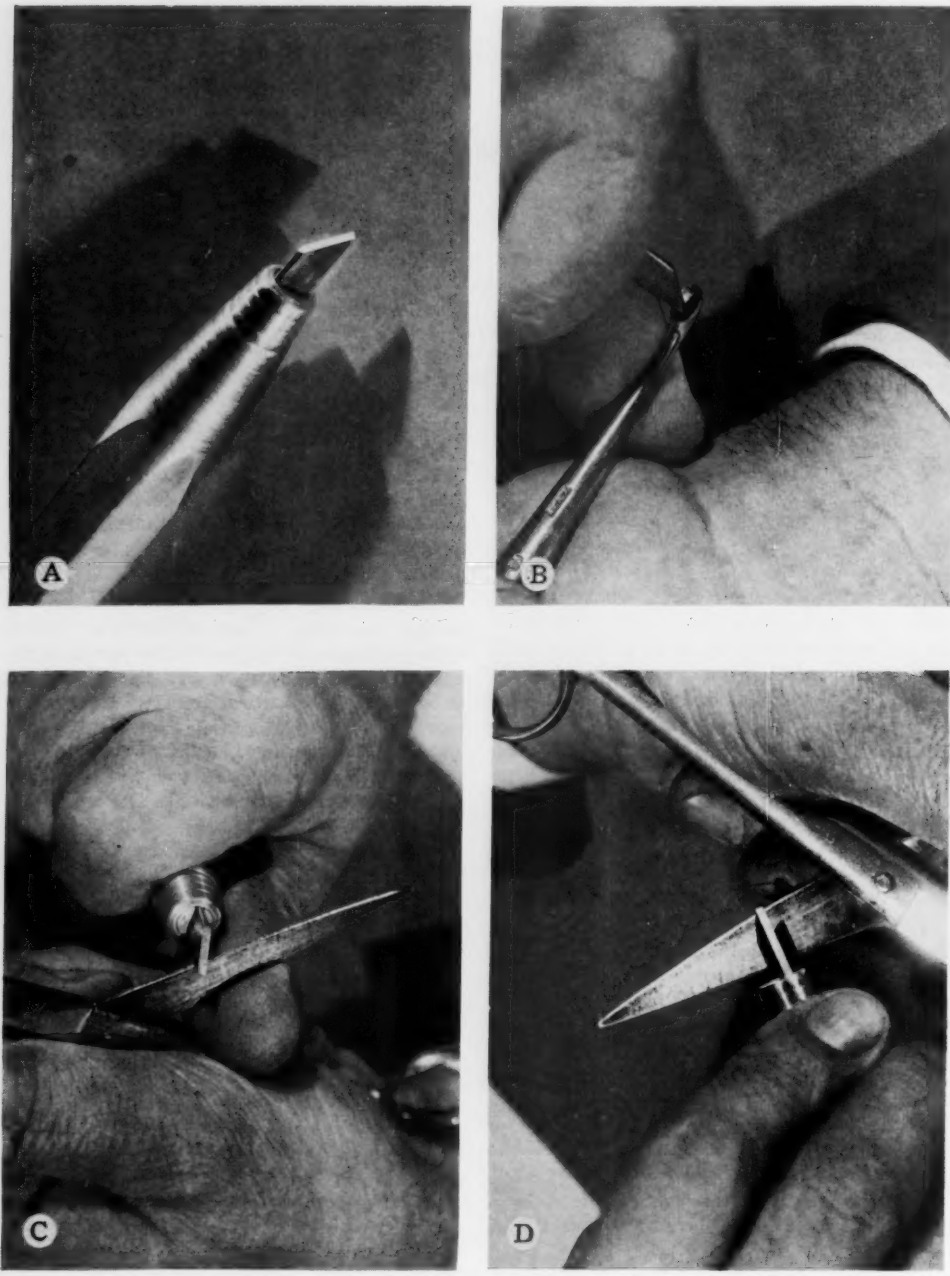


Fig. 1.—Universal sharpening tool (four views) puts a sharp burnished edge on all cutting instruments except wafer-type blades. Has five cutting edges and one burnishing edge for any type scissors, chisel, curette, or heavy knife. Takes off a microscopic amount of metal and does not change temper of metal. (Patent pending.)

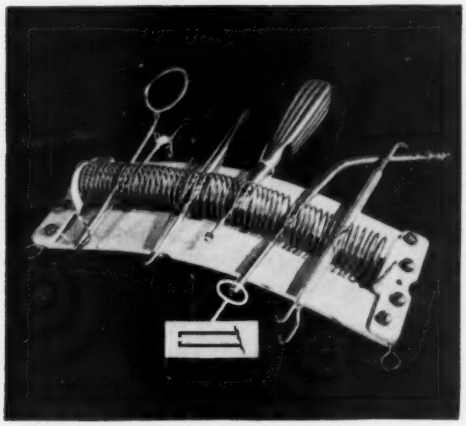


Fig. 2.—Instrument rack can be attached to sheet in various ways. Also shows suction tube with inverted edge at tip.

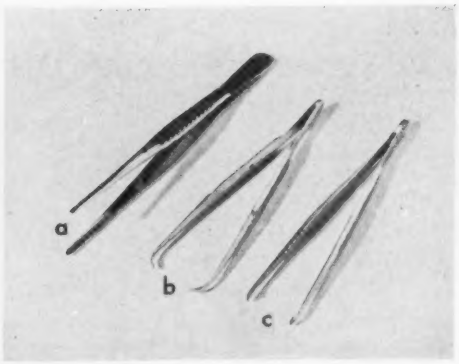


Fig. 5.—Forceps. (*a*) Hollowed tip, smooth, no serrations. For packing or for placing implant. (*b*) Right-angled forceps, strong, grasping for columella or cartilage. (*c*) Heavy-tissue forceps, not flexible, to replace eye forceps usually used.

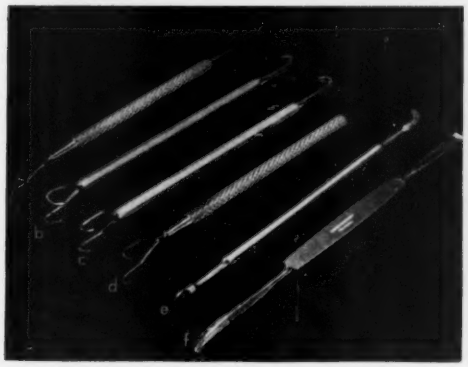


Fig. 3.—(*a*) Closed double-end retractor valuable to instructor to expose vestibule while student or assistant is working. (*b*) Closed-end retractor with cartilage hook. Most of work is done with this retractor. (*c*) Two-prong retractor with cartilage hook. (*d*) Sharp, two-prong retractor, adjustable. (*e*) Columella splitter and upper lip separator. (*f*) Double-end periosteal elevator.

Fig. 6.—Saw (handle and two blades); does the work of four saws by placing saw at end or at right angle.

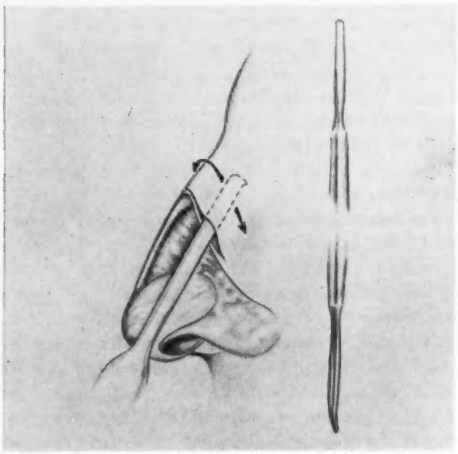


Fig. 4.—Elevation of periosteum and skin in one layer without shredding. After elevating the skin to ⅛ in. above lower edge of nasal bone, sharp cutting tip (shorter end of elevator) cuts periosteum on left just above and along lower edge and elevation is done by sweeping mesially and laterally to raise a continuous hood. Then instrument is reversed, and the double-curve end with sharp cutting section sweeps over central length of dorsum and partially elevates opposite (right) side and comes down over upper cartilages. Short end then repeats motions on right.

bony nasal bridge. We were told to take off the hump with a saw or a chisel. This was followed by lateral osteotomy, and the bones were brought into apposition. Now did the bones really make contact? If they did, it was a matter of luck. Let us see what really takes place. You have created, in cross section, a truncated bisected triangle by taking off the tip. The sides, central wall, and the septum are on the same level. Now if we bring the side walls

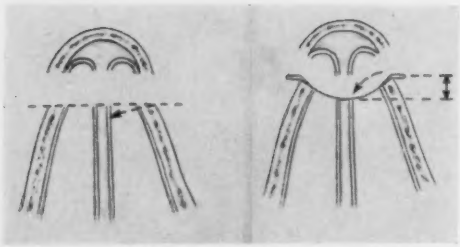


Fig. 7.—Contrast between the old and the new method of hump removal. When hump is removed with saw or chisel or rongeur, septum and nasal bones are on one plane. After osteotomy and infracture, the nasal bones are below level of septum, which protrudes. Using dorsal rocking gouge, in one motion, dorsum is removed, septum is lowered, and mucosal edges removed, permitting nasal bones to approach each other.

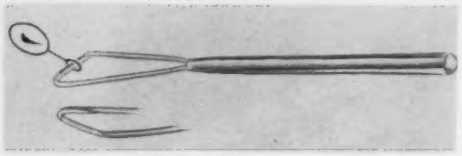


Fig. 8.—Draw knife; sharp blade drawn at an angle cuts mucosa from under edge of both nasal bones and both sides of septum following removal of hump. This permits more intimate contact of periosteum and bone.

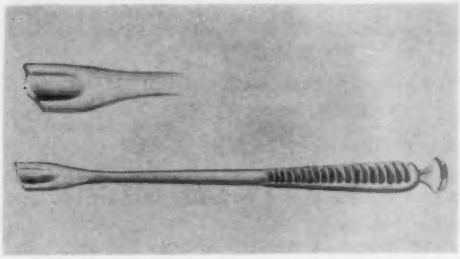
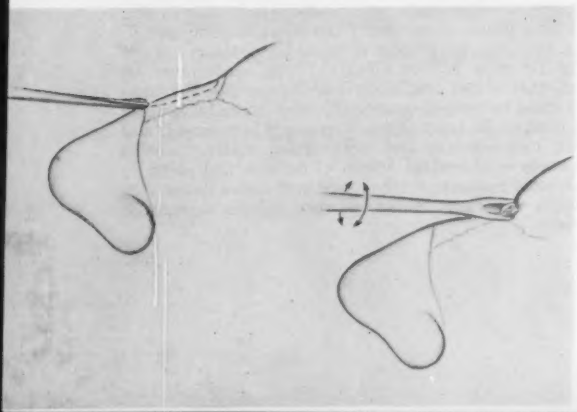


Fig. 9.—Subglabellar, or dorsal, gouge (rocking gouge).

Fig. 10.—Diagram shows placing of gouge, also rocking action to dig out the subglabellar curve.



medially, the septum must project, and if we use the Walsham forceps to bring the bones inside the maxillary edge, it aggravates this projection. In addition to this, there results four layers of membrane which interfere with bony union. I attempt to overcome this by first rasping the septum or chiseling off a sliver. To do this, one must outfracture first. Then I remove some of the mucosa from both nasal bones and both sides of the septum with a bias cutting knife or a thin perforated scraper or thin sharp rasp (Figs. 7 and 8).

During the past two years I have experimented with a special gouge, which has given me great satisfaction. It saves time in overcoming in one motion all the problems previously mentioned, and also acts as a curette to lower the nasofrontal region. It removes a half cylinder of bone and cartilage, which includes dorsal bone and septum and mucosa. It also removes bone at the nasofrontal angle and creates a satisfactory subglabellar dip or curve. It is simple to use. Place the gouge at the lower end of the nasal bones rather superficially and then tap in deeper as you proceed to the nasofrontal region. Then rock the gouge, and the piece of bone separates easily. Then if you want to deepen the curve of the subglabellar region, you place the gouge up against the bone you wish to remove, tap with the mallet, and rock it. This acts like an "on-end" curette. I do not remove all the bone debris. I push it into the gap between the upper ends of the bony walls formed by the nasal bones (Figs. 9 and 10).

Two other methods of creating a good subglabellar curve have been found very satisfactory. One has been described previously.[1] In this method, which I called the "disarticulation technique," the saw is placed on the nasal bone closer to the inner canthus. Both nasal bones and septum are cut through, and the chisel continues the bone incision until the frontal bone sound is heard. Then a broad nasal forceps, such as the Koffler, is inserted and the segment of bone is disarticulated. If the entire nose is broad, it may be necessary to place an implant along the dorsum to give a narrower appearance. If you want to put a guiding nonabsorbable surgical (silk) suture through the implant, whether cartilage or bone, I have a simple device to drill the hole. It holds the fragment from slipping while at the same time it guides the trephine (Figs. 11 and 12).

The other method permits the removal of one solid block in the nasofrontal area. After the nasal covering is elevated, a nick 2 to 3 mm. long is made on both sides through the skin at the lowest point of the triangle of bone excision. A hole is drilled through and through at this point, and a special saw blade (Tyler), something like a Gigli saw, is placed through and attached to a saw handle. The triangle of bone is separated first by sawing up toward the glabella then coming back to the original

hole and working down and forward. After the wedge is removed the nose appears like any hump nose and is so treated. If the nose is wide, it may be necessary to place an implant (Figs. 13 and 14).

The problem of lateral osteotomy may be handled in many ways. To facilitate making the incision at the pyriform crest, I like to compress the soft tissues against the bone with my closed-end retractor. This permits cleaner and easier incision. The elevation of the periosteum is done in the routine manner. Then the saw is placed as usual and the bone cut about two-thirds of the way through without cutting the mucosa and periosteum. In other words, a green-

Fig. 11.—Front and side views of patient before and after operation with use of disarticulation method for creating a subglabellar dip. Saw is placed against nasal bone, closer to inner canthus than usual, and cuts through both nasal bones and septum. A chisel continues the incision upward. Then a heavy nasal forceps grasps bony segment and disarticulates it from the frontal bone.

stick fracture should result if the saw is carefully used. I do not like any form of wide chisel or osteotome because it severs all mucosal and internal periosteum, as well as blood vessels and nerves, and results in too much mobility of nasal walls. The use of a narrow chisel to make several perforations along the intended line of fracture has much in its favor. To maintain an exact line, I place a long needle or sharp pointed wire through the region where you ordinarily make the incision to elevate the periosteum and push it toward the frontal bone.

Fig. 12.—Trephine drill for making hole in bone or cartilage for suture guide.

Fig. 13.—To remove large block from fronto-nasal region a 3-mm. incision is made on both sides of nasal bridge at apex of triangle to be removed after soft tissues have been elevated. A hole is drilled through. Incisions are protected by inserting a spring wire coil in each incision.

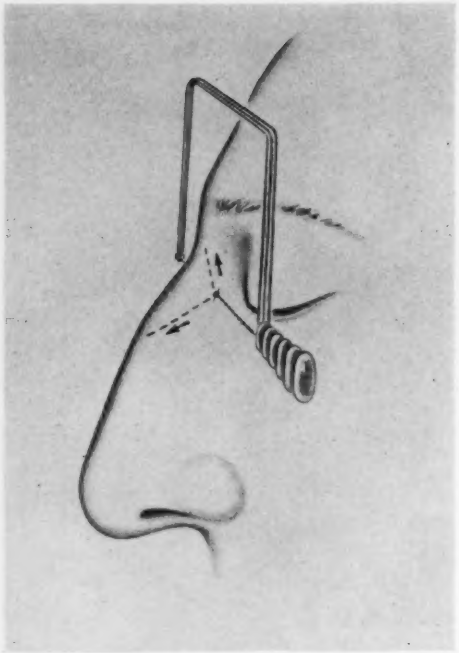


Fig. 14.—A saw blade (Tyler) which cuts in any direction is inserted and attached to handle. First saw up toward glabella. Then come back to start in hole and saw down and forward.

Fig. 15.—Guide for chisel in lateral osteotomy.

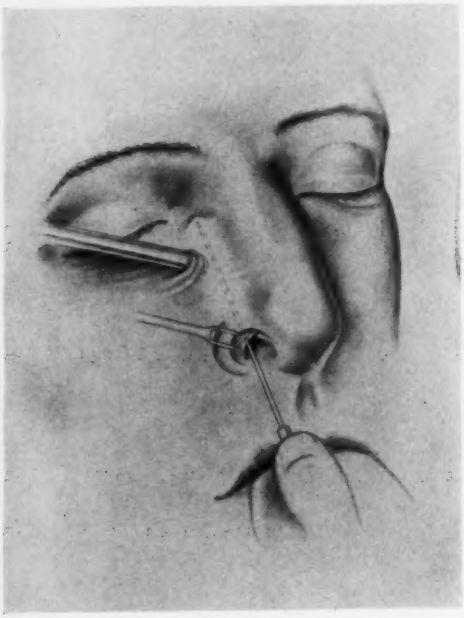


Fig. 16.—Osteotomy chisel (foreshortened to show working end). Note small lip on tip of chisel which elevates the periosteum ahead of small cutting edge of chisel. The purpose is to do away with elevating and its subsequent trauma; also, a green-stick fracture usually results, thus eliminating cutting through the internal periosteum and mucosa and large vessels. Cutting edge is 2.5 mm.

This is easily felt under the skin. The thin chisel can be inserted through this area without elevating the periosteum. Or the chisel can be plunged through the skin, either at the nasofacial groove or any place along the line of the guiding needle, even through the skin of the lower lid. Then, whether the saw or chisel has been used, I like to outfracture because the broad chisel with which the upper end of the septum and nasal bones are finally separated makes a broad lever to elevate the nasal bones with less comminution than when finger pressure is used to infracture (Fig. 15).

I have lately been using a small chisel for the osteotomy, which helps to create a green-stick fracture. Its tip also elevates the periosteum as it goes along. I find less bleeding and less postoperative swelling. There is greater ease in manipulating. An incision is made as usual, and the periosteum is elevated for only ¼ in. Then the chisel is placed on the bone and tapped to its destination (Fig. 16).

Fig. 17.—Wiring bony vault. Needle with tantalum wire goes from *a* through osteotomy gap through septum and out through opposite osteotomy and skin at *b*. Needle passes back through same opening under skin to dorsum and out at *c*. Passes under skin from *c* to *a*, then into interior of nose, out to vestibule. The part first put through *d* is pulled into vestibule, and both wires are twisted tight, and a perforated lead shot is put on and crushed. This wire completely surrounds nasal bony fragments.

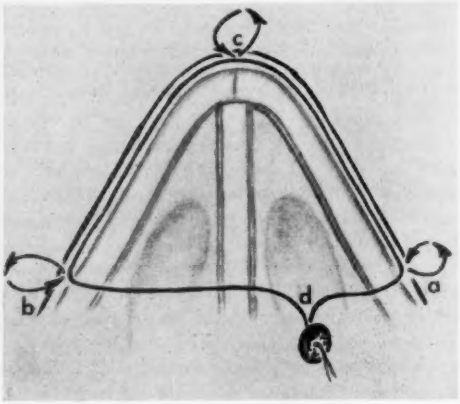


Fig. 18.—(*a*) Submucous speculum. Only one speculum used for the septum operation. (*b*) Self-retaining speculum. (*c*) Angulated retractor for dorsum. Packing speculum and only speculum used for all intranasal surgery. Thin blade with broad concave angle and blade.

How to keep the two halves of the nasal bridge from reattaching themselves to the frontal processes, thereby resulting in a broad shallow nose, has been a problem. If we could anchor some bone segments in the gap created by the osteotomy and if they would stay, it would answer our problem. I have seen no improvement in results after the use of the Walsham forceps, which is supposed to push the

Fig. 19.—Packing nose easily.

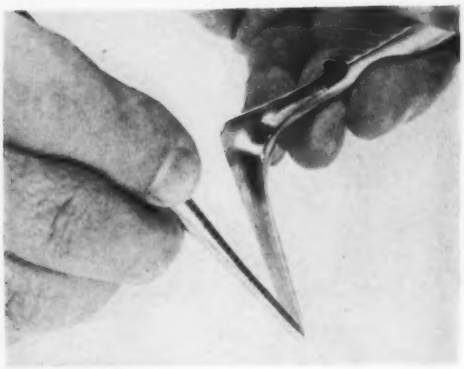


Fig. 20.—Only one-blade speculum needed. Operating instrument in right hand acts as second blade, avoids crowding nasal chamber.

Fig. 21.—Needle holder. Smooth, nonserrated jaws will not crush suture. Jaws, while flat, will hold needle curve from flattening, and return curve to flattened needle.

Fig. 22.—One type of self-adjusting nasal splint.

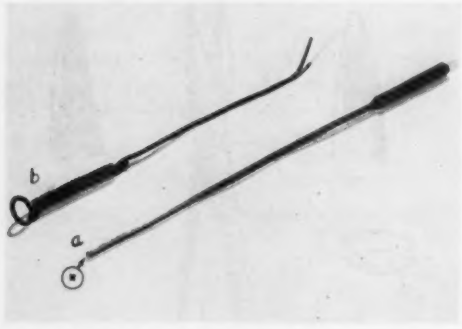
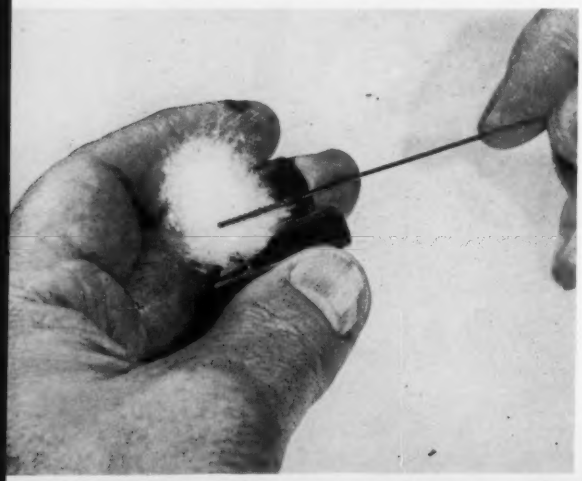


Fig. 23.—(*a*) Square-shank applicator for making tampons. (*b*) Indicator applicator. Ring shows which way the tip is bent.

Fig. 24.—Applicator maker, especially useful when wearing rubber gloves. (Patent pending.)



nasal bones into the nasal chambers mesial to the osteotomy. The same mechanical effect can be attained by infracturing and downward pressure, with less trauma to the internal periosteum and mucosa.

Lately an attempt has been made to pass a suture through the upper lateral cartilages and tie them toward the midline. This will never work. The cartilages do not control the spread of the nasal bones; rather, it is the reverse. If we can hold the bones closer to the septum for say two months, until the gap fills with bone or soft tissue, we should get a good result. I pass a needle with tantalum wire near the lower edge of the nasal bone across the base of the bony pyramid through the osteotomy incisions and through the septum, coming out through the skin. Then I pass the needle back through skin puncture, over the nasal bone to the midline, back through this puncture, and over the opposite nasal bone to the original hole; then it is reinserted so the needle comes out into the nasal vestibule. The wires are both pulled into the vestibule and twisted. Then a perforated lead shot is pushed up on the wire as far as possible and crushed, thus holding the wire. If you have difficulty in putting the needle across the osteotomy incisions, it may be made easy by elevating the nasal bones so that the gap made by the saw or chisel is wider and at a higher level (Fig. 17).

Packing the nose properly helps to maintain the severed nasal bones in their proper relations. To facilitate this procedure, I use a special one-blade speculum as a packing guide. The blade covers the incisions so there is no chance of pushing gauze between skin and bone. It is also my angulated retractor for exposing the dorsum. This speculum is very useful for all intranasal sinus surgery, removal of polyps, etc. If the septum is to be resected, a double-end instrument is the only speculum I use. It never leaves my left hand during the whole operation (Figs. 18, 19, and 20).

For years I felt that there was need for a needle holder which would prevent the flattening of the small curved needle, and to bring back the curve if it had become flat. I made one which works well and, in addition, will not crush or shred nonabsorbable surgical sutures because there are no serrations (Fig. 21).

For external dressing I have always used a copper splint to hold the fragments in place and over this a stent covering reaching over the frontal region to prevent lateral displacement of the whole nose.

In the postoperative treatment, I like, where indicated, to use a nasal splint. If we can keep stretching the fibrous tissue, which in most cases unites the nasal bridge to the maxillae, we can to a great degree prevent the broadening of the nose. My splint is self-adjusting, small enough to be worn

while reading or working, and can be used for hours at a time (Fig. 22).

Local anesthesia is, of course, the usual routine. Early in my work, I decided, after seeing some untoward results from too much cocaine absorption, to use as little of it as necessary. I found that a few drops of a mixture of equal parts of 10% cocaine and epinephrine were sufficient if used properly. I first spray the nose lightly, once or twice, and then use the same solution to swab the mucous membranes. I never use packs, which often permit the cocaine to drip into the pharynx and stomach. As a rule I do not need a speculum, although I have one which is self-retaining. My applicator has an indicator on the proximal or handle end to tell me where the tip is. If I bend the tip and apply it to the sphenopalatine ganglion area, I can tell whether it is in place by the ring end, which is always parallel to the lip. For those who have difficulty in making swabs with gloves on, or for most nurses, the applicator maker which one wears on the left middle finger is very useful. If you want to use a tampon or pack, the all-square applicator makes it simple to do. And for those of us who have the misfortune to run into severe nasal hemorrhage, we have a choanal and nasal plug made from a long dental roll. It will help control posterior nasal bleeding without blocking the Eustachian tubes (Figs. 23, 24, 25, and 26).

I have tried to show some refinements in the technique of surgery of the nasal bony bridge which were attained by the application of mechanical principles. In addition, one of the purposes of this presentation is to demonstrate how a hobby can be applied to a practical utilitarian use. Most of these instruments were made at my desk with simple hand tools from metal scrap or old instruments, some dating back to my student days. Tools that simplify a job add satisfaction to one's work and definitely produce better results.

555 Park Ave. (21).

Fig. 25.—Head of applicator depends on amount of cotton left projecting and pressure against finger.

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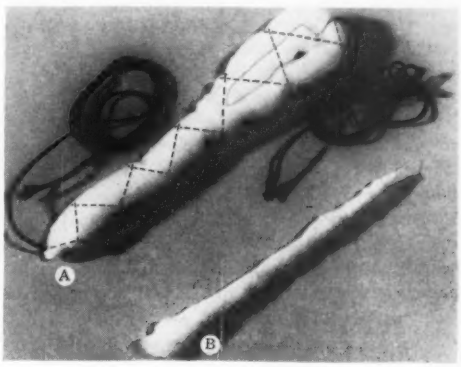
Fig. 26.—*A*, choanal plug for posterior bleeding. Made from dental roll. Heavy thread is passed thru the cotton, and the stitching is reversed to prevent stretching. *B*, tampon for packing made with square-shank applicator.



USE OF HYDROCORTISONE IN COSTEN'S SYNDROME

WILL P. PIRKEY, M.D., Pittsburgh

Pain about the head and neck is probably the commonest complaint of a patient seeking care from an otolaryngologist. Although this symptom is often very obscure, it is none the less a challenge. Fortunately, owing to the work of Wolfe, Seydell, Williams, Horton, Costen, and others, the diagnosis and treatment of many of the conditions have been placed at our finger tips.

A surprising number of patients presenting themselves to me have had pain referable to the temporomandibular joint. This symptom complex was first described by Costen in 1934.[1] As Costen states, "Mandibular joint neuralgia may be considered of common occurrence and should be investigated in any case of facial pain or headache not accountable from other sources."[2] Unfortunately, the condition is still overlooked, and many patients go from doctor to doctor, without obtaining relief. The pain may be so mild as to be mistaken for a chronic neurotic symptom or so severe as to be misdiagnosed as tic douloureux. It may involve the ear, temporomandibular joint, eyes, cheek, parotid region, tongue, pharynx, occiput, vertex, neck, or area along the mandible itself. It embraces some or all of the usual distribution of the fifth cranial nerve and is a member of the reflexor secondary group of neuralgias in which mechanical irritation of branches reflects pain in the standard cranial areas (Costen).[3]

The anatomy, the nerve pathways, and the diagnosis have been well covered by Costen,* Greer and Withers,[5] and Epstein [6] and will not be covered here. The diagnosis depends on the history, the physical findings, x-ray findings, and the test of treatment.

The recognized treatment usually falls within the realm of dentistry, and this paper is not presented to suggest a substitute or new treatment of the basic pathology.

The relief of pain resulting from correction of the joint pathology is usually a rather gradual experience. In an attempt to give the patient immediate relief of pain while his occlusion is being balanced, and as a "test of treatment," I decided to inject the temporomandibular-joint capsule with hydrocortisone (Hydrocortone). The rational of this treatment was based on the work of Bauer [7] showing that noninfectious functional trauma to the temporomandibular joint promotes the development of osteoarthritis deformans.

The injection of hydrocortisone into the temporomandibular joint is therefore a test of treatment and gives the patient relief of pain while his dental problems are being corrected.

Three hundred fifty patients have had their temporomandibular joints injected in the last two years. The results have been excellent, as will be shown in the following paragraphs.

The presenting symptom and the basis upon which the patient was given the temporomandibular-joint injection was pain. In 255 the pain was referred to the ear and the preauricular area; in 50 the pain was in the tongue and pharynx; in 35 the pain was in the lateral aspect of the neck, with radiation superiorly toward the ear; in 10 there was a generalized pain which could not be localized in the joint area, but since no other definite cause could be found, the temporomandibular joint was incriminated.

In all but 46 of the patients hypermotility of the temporomandibular joint with tenderness on external and/or internal palpation was elicited. Various other symptoms were also present, i.e., stuffiness in the ears, diminished hearing, burning of the tongue, dryness in the mouth, etc., but, as stated before, pain was the only symptom followed.

X-rays were taken in 113 of the cases; all were reported as showing malfunctions of the temporomandibular joint.

History of precipitating incidents was found in 144 cases. They ran the gamut of those given by the previously mentioned authors.

The injection was made as follows: A 2-cc. syringe, with a 22 or 25 gauge needle ¾ in. long, was selected. One cubic centimeter of hydrocortisone was aspirated into the syringe. The temporomandibular joint was palpated and the area cleaned with alcohol. The patient was asked to open his mouth, and the needle was inserted perpendicular to the mandible, ½ in. anterior to the tragus and approximately ½ in. in depth. The plunger was pulled back to be sure that the needle was in the joint capsule, and the 1 cc. was injected. No untoward reactions resulted from missing the joint, but no relief was obtained if the medication merely in-

From the Department of Otolaryngology, Mercy Hospital.

* References 1 to 4.

filtrated the surrounding tissue. The patient was instructed that there might be some slight feeling of fullness or tenderness in the joint for 2 to 3 hours and that there might be no relief of the symptoms for 12 to 16 hours. Patients were advised to return to the office in three to six days for follow-up examinations and at monthly intervals thereafter or until pain returned. They were also instructed to consult their dentists as soon as possible for correction of their bites. The problem was discussed with the dentist, if it was desired.

Of the 350 patients given injections, only 10 failed to return and are excluded from the report. Three hundred sixteen had complete relief of symptoms in 24 to 36 hours. The pain was absent for an average of five and one-half months. However, in 15 the relief was present for only 7 to 14 days, and 14 had no relief at any time. In 15 the pain was absent for from 20 to 30 days, in 40 from 4 to 6 weeks, in 130 from 3 to 6 months, and in 126 for more than 6 months.

The patients who had their bites corrected were all free of symptoms on their last examination. However, a number of patients did not consult their dentists or failed to have the prescribed correction made; 107 patients had a second temporomandibular-joint injection, and 51 have had three injections. The same relief was obtained following the third injection as was obtained from the first.

An additional weapon in the diagnosis and treatment of pain about the head and neck is presented. The results obtained in its use in 350 consecutive patients are given. It should be again emphasized that this is an additional test of treatment and does not correct the underlying predisposing condition.

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A GRAPHIC METHOD OF DETERMINING BINAURAL HEARING LOSS

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It becomes necessary in a clinical situation to calculate the binaural hearing loss of a hard of hearing person quickly. In a typical audiological clinical set-up, there is often too little time to spend in the actual interpretations of test findings to the client because of the great amount of time spent on the test itself. A complete hearing examination might well run into two or three hours, and so any short cut in arithmetical computation could add important counseling minutes with the client.

The reasons for troubling ourselves with the binaural percentage loss are manifold. Aside from offering an easy way of communicating the extent of the hearing disability to the patient, it offers the clinician a numerical value for comparisons between the same or other cases. Various governmental agencies interested in awarding compensation to certain deafened persons desire numerical values, rather than qualitative interpretations.

A method presented by the American Medical Association from a study of Fowler and Sabine provides the basis for a quick way of obtaining this binaural percentage loss. As is known, in this initial calculation the better ear is given seven times the importance of the poorer ear in determining an individual's bilateral hearing handicap. First, the percentage of loss of the better ear is multiplied by seven. This is added to the percentage of loss of the poorer ear. The sum of seven times the better ear and one times the poorer ear's percentage of loss is then divided by eight. The resulting figure is the combined percentage of hearing loss for the two ears when both are in use.

Using this basic procedure, I constructed a chart in which the vertical represented the percentage loss of the better ear and the horizontal the percentage loss of the worse. The intersection represented the combined percentage loss for both ears. This process eliminates the burdensome computations, and necessitates just the addition of the individual frequency per cent losses.

1007 E. Huron St.

Percentage of Hearing Loss in Worse Ear

Percentage of Hearing Loss in Better Ear	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
5	5.0	5.6	6.3	6.9	7.5	8.1	8.8	9.4	10.0	10.6	11.3	11.9	12.5	13.1	13.8	14.4	15.0	15.6	16.3	16.9
10	....	10.0	10.6	11.3	11.9	12.5	13.1	13.8	14.4	15.0	15.6	16.3	16.9	17.5	18.1	18.8	19.4	20.0	20.6	21.3
15	....	....	15.0	15.6	16.3	16.9	17.5	18.1	18.8	19.4	20.0	20.6	21.3	21.9	22.5	23.1	23.8	24.4	25.0	25.6
20	....	....	....	20.0	20.6	21.3	21.9	22.5	23.1	23.8	24.4	25.0	25.6	26.3	26.9	27.5	28.1	28.8	29.4	30.0
25	....	....	....	....	25.0	25.6	26.3	26.9	27.5	28.1	28.8	29.4	30.0	30.6	31.3	31.9	32.5	33.1	33.8	34.4
30	....	....	....	....	....	30.0	30.6	31.3	31.9	32.5	33.1	33.8	34.4	35.0	35.6	36.3	36.9	37.5	38.1	38.8
35	....	....	....	....	....	....	35.0	35.6	36.3	36.9	37.5	38.1	38.8	39.4	40.0	40.6	41.3	41.9	42.5	42.1
40	....	....	....	....	....	....	....	40.0	40.6	41.3	41.9	42.5	43.1	43.8	44.4	45.0	45.6	46.3	46.9	47.5
45	....	....	....	....	....	....	....	....	45.0	45.6	46.3	46.9	47.5	48.1	48.8	49.4	50.0	50.6	51.3	51.9
50	....	....	....	....	....	....	....	....	....	50.0	50.6	51.3	51.9	52.5	53.1	53.8	54.4	55.0	55.6	56.3
55	....	....	....	....	....	....	....	....	....	....	55.0	55.6	56.3	56.9	57.5	58.1	58.8	59.4	60.0	60.6
60	....	....	....	....	....	....	....	....	....	....	....	60.0	60.6	61.3	61.9	62.5	63.1	63.8	64.4	65.0
65	....	....	....	....	....	....	....	....	....	....	....	....	65.0	65.6	66.3	66.9	67.5	68.1	68.8	69.4
70	....	....	....	....	....	....	....	....	....	....	....	....	....	70.0	70.6	71.3	71.9	72.5	73.1	73.8
75	....	....	....	....	....	....	....	....	....	....	....	....	....	....	75.0	75.6	76.3	76.9	77.5	78.1
80	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	80.0	80.6	81.3	81.9	82.5
85	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	85.0	85.6	86.3	86.9
90	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	90.0	90.6	91.3
95	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	95.0	95.6
100	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	100.0

AURICULOSTOMY

C. F. McDONALD, M.D.
and
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It has been predicted by an official of one of the larger hearing-aid companies that in the near future all hearing aids, together with power supply and microphone, will be worn entirely on the head in some form or another. Even at this time hearing aids completely incorporated in a spectacle frame are being perfected. A receiver for each ear greatly improves auditory perspective, and it is the head-borne instrument which can provide two receivers most effectively. The recent use of the transistor, printed circuit, and crystal detector has made it possible to build hearing aids of such efficiency and small size that a complete instrument can all but be worn in the auditory meatus itself.

Most hearing aids in use today require heavy batteries and a microphone, which must be worn under clothing. Long wires and tubes cause loss in power and extraneous noise. Protruding buttons and wires are conspicuous. Delicate connections frequently fail in the case of an active deafened person. Even with the present head-borne instruments the tube or wire is conspicuous and exposed to damage.

An auriculostomy, with properly fitted mold, obviates these disadvantages and makes the hearing aid much more "wearable" and inconspicuous, with elimination of lost power and most extraneous noise.

The operation of auriculostomy consists of making a permanent hole through the auricle to provide the shortest and least conspicuous route from the receiver of the hearing aid to the external meatus. This perforation is in the floor of the cavum tympani, behind the antitragus. Posteriorly it emerges at the lower end of the postauricular sulcus, behind the lobule of the ear.

Any physician qualified to do minor surgery can perform this operation. The cartilage of the auricle should, of course, be treated with careful asepsis and respect to avoid postoperative perichondritis. Its edges should be protected with a pad of subcutaneous tissue and skin, so pressure of the mold will not cause irritation and possible ulceration subsequently.

The following procedure gave a very satisfactory result:

After the usual skin preparation, the area is infiltrated with slightly less than 2 cc. of 2% procaine

Fig. 1.—Auriculostomy.

with epinephrine. A postauricular incision about 2 cm. long is made parallel and about 2 mm. lateral to the postauricular sulcus. It ends just within the lobule. The perichondrium is easily identified and incised. After elevating the perichondrium about

Fig. 2.—Button and wire of old-type receiver.

Fig. 3.—*A*, new mold connected to skull temple of a shell frame (head-borne hearing aid). *B*, frontal view of patient with head-borne hearing aid.

5 mm. to each side of the incision, a button of cartilage, about 8 mm. in diameter, is removed, leaving the perichondrium and skin of the anterior side intact. A single mattress suture engaged both layers of perichondrium and closed the skin incision. The suture was removed on the 5th day, and on about the 12th day actual cautery with a 2-mm. electrode was used to perforate through the center of the cartilaginous defect. Three days later a plastic plug 4 mm. in diameter was inserted until epithelialization was complete.

A one-piece impression, including the external meatus and the new aperture, was made. From this a mold was made by the ingenious patient, Mr. Charles Strzalkowski, who conceived the project originally. It is not visible except on inspection from the side. The lower end of the mold, behind the lobule, has a female opening which receives the male fitting attached to the tube of the receiver.

At the present time the patient uses his old-type aid with this mold. The tube goes behind, under his collar, but he states that his aid works better and that he has less trouble with it. He is delighted with the inconspicuous feature of the fitting.

With the head-borne instrument, auriculostomy will not only make the connections to the external meatus indiscernible but give better anchorage and provide some barrier to "feed back," thus improving "wearability" in most important respects.

We sincerely believe that auriculostomy has considerable merit because of its inherent advantages.

It is obvious that this operation should not be done if the patient cannot tolerate a hearing aid. This, of course, is not uncommon in people with perceptive deafness, when recruitment and loss of discrimination occur with relatively slight and impractical amounts of amplification.

It must also be made clear to the patient that auriculostomy in no way improves the ear physiologically, as does the fenestration operation, with which auriculostomy may become confused in the lay mind.

We wish to point out that auriculostomy should impose improved relations and collaboration between family physician, otologist, and hearing-aid audiologist. This cooperation has not been evident in the past—much to the detriment of the patient.

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Progress in Otolaryngology

INTRACRANIAL COMPLICATIONS IN OTOLARYNGOLOGY

Summaries of the Bibliographic Material Available in the Field of Otolaryngology for 1951-1954

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THE DECREASE in otorhinogenous intracranial complications has been remarkable since the availability of chemotherapeutic and antibiotic agents in the past 15 years. Such complications, however, still occur not uncommonly. This gratifying advance, whereas mainly due to the above-mentioned agents, must also be attributed to a better understanding of nasal physiology, better surgical techniques for sinus and ear operations, and more adequate allergy management. These dreaded complications will continue to be less lethal and less frequent if routine cultures, sensitivity tests, and specific antibiotics in adequate doses are employed. There is almost unanimous agreement, however, that once the complication has been established, adequate surgical drainage, in addition to chemotherapeutic and antibiotic agents, must be instituted to effect a cure. However, the surgical procedure usually may be more conservative than formerly, thus leading to less postoperative deformity and a smoother, more pleasant convalescence for the patient.

The material is classified as follows:

A. Rhinogenic Complications
   1. Frontal bone osteomyelitis
   2. Brain abscess
   3. Extradural and subdural abscesses
   4. Cerebral vein thrombosis
   5. Meningitis

B. Otogenic Complications
   1. Meningitis
   2. Otitic hydrocephalus
   3. Virus encephalitis with hemorrhagic myringitis bullosa
   4. Extradural and subdural abscesses
   5. Lateral sinus thrombosis
   6. Temporal lobe and cerebellar abscesses
   7. Extradural hemorrhage

C. Miscellaneous
   1. Otic and nasal meningoceles
   2. Temporal lobe herniation
   3. Jugular foramen syndrome
   4. Fractures of petrous pyramid

RHINOGENIC COMPLICATIONS

Simpson [1] advocates using specific antibiotics in the treatment of osteomyelitis of the skull resulting from frontal and ethmoid sinusitis. Many of such patients are poorly nourished; therefore, a well-balanced, high-caloric, high-carbohydrate, high-vitamin, high-protein diet, supplemented by iron, should be instituted preoperatively. If a patient with an acute frontal or ethmoid infection develops severe pain, high temperature, tenderness, and external swelling despite antibiotics and intranasal medications, then an external drainage of the frontal or ethmoid sinuses or both should be done. Such conservative surgery will in many instances prevent the development or spread of an osteomyelitis of the frontal bone. Simpson also states that if a full-blown osteomyelitis is already present when the patient is seen by the rhinologist, adequate removal of the osteomyelitic bone must be performed, preferably leaving the wound open. Later, a complete exenteration of the involved frontal and ethmoid sinuses must be done after the osteomyelitis is cleared. After sufficient time has elapsed to insure that the osteomyelitis is controlled, a plastic closure of the frontal area should be done. If osteogenesis is insufficient, the bone defect may be closed with insertion of bone chips, tantalum plate, or bone graft.

Mirmelstein [2] reviews the pathogenesis of osteomyelitis of the skull following acute frontal sinusitis. He presents two such cases. The first patient was treated with specific antibiotics, frontal trephination, and

later antrostomies and infracture of the middle turbinates, with complete recovery. The second patient required more extensive surgery. Since the patient did not respond to bilateral antrostomies and intranasal ethmoidectomy, it was necessary to perform a bilateral radical frontal operation and later a radical excision of the frontal bone with saucerization and curettage of the frontals. Following this procedure, convalescence was uneventful, and a tantalum plate was inserted later.

Shaw [3] points out that formerly frontal osteomyelitis developing in recent postoperative patients gave a poorer prognosis for cure than the type arising spontaneously. This is apparently due to the surgical opening-up of vascular spaces in bone which is already the site of localized osteitis or osteomyelitis. He further summarizes the current objects of therapy in this condition as follows: (*a*) provision of adequate local drainage, (*b*) early and effective sterilization of the infected bone, and (*c*) local removal of residual sequestra. He presents an illustrative case.

Johnson [4] reports three cases of frontal osteomyelitis, two of which were complicated by extradural abscesses (both) and frontal lobe abscess (one). These patients were treated with specific antibiotics, adequate removal of the osteomyelitic bone, and drainage of the extradural and brain abscesses, with two recoveries and one death. The patient who died was found on autopsy to have an extensive unrecognized malignant glioma of both frontal lobes. Johnson points out that with sulfonamides and antibiotics we may no longer expect to find the classic forehead edema associated with frontal osteomyelitis, and that the x-rays may not reveal the presence of osteomyelitis as soon as in the prechemotherapeutic days.

Harrison [5] presents six cases of frontal osteomyelitis, all treated with specific antibiotics and adequate surgery. There were five survivals and one death; the death resulted from an extensive subdural space infection and softening of one frontal lobe. Harrison advocates the coronal incision, as this incision gives good exposure of the frontal bone and frontal sinus with minimal postoperative scarring.

Brain abscess of rhinal origin has a much better prognosis now than in the prechemotherapeutic days. There is still, however, much variation in opinion in regard to the surgical management of the abscess.

McCaskey [6] reviews the pathogenesis and diagnosis of rhinogenic brain abscess and reports a case of frontal lobe abscess in a 30-year-old man following acute frontal sinusitis. The first surgical procedure performed was a radical frontal sinusotomy and insertion of a Pezzer catheter into the brain abscess cavity. After an initial improvement the patient's condition deteriorated with progression of aphasia, hemiparesis, and involvement of the third and seventh cranial nerves. A neurosurgical operation was then carried out, turning down a large frontal bone flap via a coronal incision, identification of the abscess, and then removal of the entire lining of the abscess cavity. The patient eventually recovered, but he had residual Jacksonian convulsions and personality changes. McCaskey states that encapsulation of the abscess is essential for recovery and that when the abscess is well encapsulated it should be excised.

Shuster and associates [7] report an interesting case of extradural and subdural empyema and frontal lobe abscess following an acute pansinusitis in a 16-year-old Negro boy. The patient had a stormy postoperative course, but he eventually made a complete recovery. A frontal sinusotomy was performed, plus removal of the posterior plate of the frontal, drainage of the extradural and subdural collections of pus, and insertion of a drain in the frontal lobe abscess cavity. Adequate antibiotics were given postoperatively, although no organism could be cultured from the abscess contents. The authors point out that too radical excision or rough handling of the brain is more likely to add to the complications than is minimal manipulation with adequate drainage. A tube should be left in place in the brain abscess cavity for weeks, and frequent removal and rein-

sertion should be avoided. Irrigation of the abscess cavity with penicillin is of questionable value.

Skolnik and associates [8] point out that the widespread use of antibiotics and chemotherapy has not eradicated severe intracranial complications of acute and chronic infections of the nose and paranasal sinuses. They present five patients who developed the various complications of extradural and subdural abscesses, frontal lobe abscess, and meningitis. All were treated with adequate surgical exploration and drainage of the abscesses. There were four recoveries and one death.

The mortality of subdural empyema, formerly almost 100%, continues to decrease with improved management.

Pitts [9] reports four cases of subdural abscess following acute frontal sinusitis; three survived. He reviews the diagnosis, pathogenesis, and treatment of this condition. The sudden onset of Jacksonian convulsions and focal neurologic signs in the presence of acute suppurative frontal sinusitis usually indicates the presence of subdural abscess. Early diagnosis, massive doses of specific antibiotics, and adequate surgical drainage of the empyema through strategically placed burr holes are essential to recovery. The frontal focus of infection is eradicated at the same time, if possible. In three of the four patients, the posterior frontal plate was intact, indicating the usual route of spread of the infection through thrombophlebitic vessels in the bone, thus emphasizing the necessity of removing the posterior frontal plate in suspected intracranial complications, even though the bone looks normal. The frontal defect may be corrected later by means of a tantalum plate inserted through a coronal incision, with little resultant deformity. Unfortunately, Jacksonian convulsions are all too often serious sequelae in these patients.

Wood [10] presents 11 cases of subdural empyema; 6 followed frontal sinusitis, 2 followed antral sinusitis, 2 arose from otitis media, and 1 was caused by a dural tear during an intranasal ethmoidectomy. Prompt drainage through multiple burr holes, along with adequate penicillin therapy, was the treatment given; there were seven recoveries and four deaths. Wood states that once the infection has entered the subdural space the primary focus of the infection becomes secondary in importance and can wait for later treatment. Jacksonian convulsions were found to be frequent sequelae. Wood described a new clinical entity of chronic subdural granuloma, which he attributes to delayed or inadequate subdural drainage.

Chignell [11] reports three cases of acute frontal sinusitis, followed by thrombosis of the superficial cortical veins and multiple resulting complications. The patients were treated with adequate sulfonamides and penicillin, adequate surgical drainage, and spinal-fluid taps, with two recoveries and one death. The diagnosis of thrombosis of the cerebral veins was established by falling white blood cell count and temperature in the presence of rapidly rising spinal-fluid pressure and fluctuating neurological signs.

Dukes and Lore [12] report an unusual case of a 5-year-old boy who developed pneumococcic meningitis following accidental penetration of a long wooden splinter through his nose into the calvarium. Six weeks later the foreign body extruded into the right naris and was easily removed with the fingers. The child was treated with high doses of penicillin and sulfonamides, which controlled the meningitis nicely, and the recovery was uneventful. The authors feel that the conservative management in this type of case is superior to a radical attempt to remove the foreign body.

OTOGENIC COMPLICATIONS

McLay [13] reviews 32 cases of otogenic meningitis treated from 1938-1952, with 19 recoveries and 13 deaths, a recovery rate of 59%. Of the 13 cases treated with sulfonamides alone, the recovery rate was 38%. Of the cases treated with systemic and intrathecal penicillin and systemic sulfonamides, the recovery rate was 74%. McLay feels that most cases of acute otitis media and meningitis (more commonly found in children) may be cured without surgically treating the ear. However, in the meningitis

resulting from chronic suppurative otitis media and mastoiditis a radical mastoidectomy should be done to eradicate the primary focus of infection.

Martin [14] reports a typical case of otitic hydrocephalus (or "cortical thrombophlebitis," as some writers prefer) occurring in a 32-year-old man with chronic suppurative otitis media. This patient developed frontal headache, earache, high fever, and diminished hearing accompanying an exacerbation of the chronic otitis media. He had papilledema and a sixth-nerve paresis on the side of the otitis media. The spinal-fluid pressure was elevated, the fluid was clear, and the protein content was normal, as is typical in this condition. The patient was treated by radical mastoidectomy, evacuation of a large infected clot in the sigmoid sinus, obliteration of the sinus by packing, and ligation of the jugular vein in the neck. Adequate systemic penicillin and streptomycin were given, as were repeated spinal taps. The recovery was complete.

Dawes [15] reviews an interesting series of nine patients who developed symptoms and signs of intracranial complications accompanying myringitis bullosa hemorrhagica. The intracranial signs were as follows: stupor, drowsiness, and coma (two cases); slow cerebration, confusion, disorientation, or emotional changes (five cases); aphasia (two cases); flaccid hemiplegia (three cases); epileptiform fits, hemianopsia (one case); transient ocular paralysis (one case); nystagmus, vertigo, and vomiting (two cases); hyperesthesia of the 5th nerve and fleeting palsies of the 10th nerve (one case); facial paralysis (one case). In all of these cases the spinal fluid sugar content was normal and the cultures sterile. Also, the pressure was usually elevated and the cell count was elevated, with usually a preponderance of lymphocytes, tending to support the current belief that this condition is caused by a virus and the complication a virus encephalitis. There is no specific therapy for this condition. If secondary suppurative lesions appear, e. g., acute suppurative otitis media, sulfonamides or penicillin should be given. The only indication for surgical treatment is an unsatisfactory progress of the otitis media. Removal of spinal fluid by lumbar tap is useful to lower the increased spinal-fluid pressure, but decompression procedures are usually not necessary. The prognosis for recovery is excellent. In this series all nine patients recovered.

Sultana [16] reports an unusual case of acute pneumococcic purulent otitis media in an 8-week-old infant followed by the concurrent development of a subperiosteal abscess and an extradural abscess. The infant was treated with penicillin and chlortetracycline (Aureomycin). Simple mastoidectomy with adequate drainage of the abscesses was performed, with complete recovery of the infant.

Gabriel [17] reports a case of lateral sinus thrombosis complicated by otitic hydrocephalus with seventh nerve and contralateral sixth nerve paralysis, occurring as a result of an acute exacerbation of chronic suppurative otitis media in a 16-year-old boy. The diagnosis of otitic hydrocephalus was confirmed by the presence of bilateral papilledema and clear spinal fluid under increased pressure. The patient was treated by mastoidectomy, systemic sulfonamides and penicillin, and repeated spinal taps, with complete recovery.

Wood [18] reports his personal experience in handling 41 cases of brain abscess, mostly otogenic in origin. The brain abscesses were treated by repeated aspiration and antibiotic replacement through appropriately placed burr holes. This conservative regimen, accompanied by systemic sulfonamides and penicillin, usually resulted in crenation of the abscess to a small innocuous scar, the process being visualized by contrast roentgenography using thorium dioxide (Thorotrast). A few cases failed to crenate, necessitating surgical excision of the abscess. Eradication of the primary focus is essential to prevent recurrence of the abscess.

Which operation is done first (the mastoidectomy or the drainage of the brain abscess) should depend on the circumstances surrounding the individual patient. By this means of therapy, there were 8 deaths out

of 33 otogenic abscesses, or a mortality rate of 22.9%.

Davis [19] reviews the anatomy and pathogenesis of otogenic cerebellar abscesses. He emphasizes the need to do a complete simple mastoidectomy as the first surgical procedure when an otogenic cerebellar abscess is suspected or diagnosed. He states that the cerebellar abscess is more easily located by an exploration in front of the sigmoid sinus. Also, it is safer to tap the abscess through its stalk or path of infection than through a suboccipital craniotomy.

Appleton [20] reports four cases of otogenic meningitis. They were treated by early surgical eradication of the primary aural focus, intrathecal streptomycin, and systemic streptomycin and sulfamethazine, with all four patients recovering. He stresses the importance of aural cultures, sensitivity studies, the use of specific antibiotics, and the value of neurosurgical collaboration. The pathways of infection were as follows: the tympanomastoid route (one case), the labyrinthine route (two cases), and the petrous apex route (one case).

Maxwell [21] reports two unusual cases of recurring otogenic meningitis occurring in 5-year-old children. The first child's meningitis resulted from a transverse fracture through the petrous pyramid. At operation it was found that the dura was trapped in the fracture line. It was concluded that this vascular meningeal cuff provided the pathway of infection from the ear to the subarachnoid space. After the dura was freed from the fracture line through a neurosurgical approach, the child remained well. The second case of meningitis was due to the spread of infection from the middle-ear cavity to the stalk of a meningocele which penetrated a pneumatic cell in the petrous apex. There had been no spontaneous otorrhea to suggest open communication between the middle ear and the subarachnoid space, and it was assumed that the infection proceeded via vascular channels. After the meningocele was freed up through a temporal approach and the petrous defect was covered with absorbable gelatin sponge (Gelfoam) and bone wax, the child had no more difficulty.

Stamm [22] discusses the significance of aphasia in otology, emphasizing the importance of the otologist's participation in aphasia diagnostic problems. Aphasia may be divided into the following groups: (1) motor aphasia, (2) sensory aphasia, (3) global aphasia, and (4) amnesic aphasia. He presents a case of motor aphasia in a 56-year-old man with vascular thrombosis in Broca's area and a case of amnesic aphasia in an 81-year-old woman with otogenic meningitis.

Tamari and Henner [23] present three cases of intracranial otogenic complications which developed in patients who were being treated actively with antibiotics for acute otitis media. There was one complete recovery, one permanent blindness resulting from otitic hydrocephalus, and one death from purulent meningitis and lateral and cavernous sinus thrombosis. The authors believe penicillin to be the drug of choice in the treatment of acute otitis media but deplore the haphazard administration of other antibiotics if penicillin does not prove to be effective. They further emphasize adequate and thorough mastoid surgery when such is indicated.

Stuart and associates [24] review the problem of cerebral venous thrombosis occurring as a complication of acute middle-ear or sinus infections. The usual signs of focal seizures, hemiparesis, and signs of meningeal irritation make differentiation from brain abscess difficult. The frequent occurrence of brachiofacial seizures and palsies in this complication is pointed out. The authors submit that cerebral vein thrombosis is an important source of epilepsy and persistent neurological defects. The importance of eradication of the primary source of infection is emphasized, as is the use of chemotherapy.

Schneider and Hegarty [25] report two cases of the very rare complication of massive extradural hemorrhage of otorhinogenic origin. The first of these cases had a massive epidural hemorrhage (probably from the middle meningeal artery), secondary to chronic suppurative otitis media and mas-

toiditis, with a rapid downhill course and death. Treatment was delayed because brain abscess was the original diagnosis. The second patient developed frontal headache and drowsiness three weeks after the successful treatment of a furuncle on the nasal ala with penicillin. On operation he was found to have an area of osteomyelitis of the frontal bone, with a massive extradural anterior fossa hemorrhage. The patient recovered. The authors point out that this condition is rare but should be considered in otorhinogenic intracranial infections which develop signs of a tentorial pressure cone. Early operation is imperative.

Prazic and Grcevic [26] report an unusual case of tumor of the pineal gland associated with otitis media and meningitis. The patient was subjected to radical mastoid surgery for cholesteatomatous otitis media and meningitis, with initial recovery. Sudden death of the patient eight days later apparently resulted from traumatic surgical hemorrhage into the pineal tumor, which was discovered only at postmortem examination. The symptomatology of pineal tumors is uncertain and not easily distinguishable.

Bradburn [27] reports the unusual case of a 4-year-old Navajo girl who had (1) gonorrheal vulvovaginitis; (2) gonorrheal mastoiditis and petrositis, left; (3) tuberculous mastoiditis and petrositis, left; (4) septic thrombosis of the lateral sinus, left; (5) generalized bovine tuberculosis; (6) tuberculous otitis media, right, and, possibly, (7) brucellosis. Aside from its very unusual nature, the case demonstrated that lateral sinus thrombosis may develop in the presence of antibiotic therapy and that its symptoms are usually masked by the antibiotics.

Shuster [28] reemphasizes the fact that brain abscesses of otic and rhinal origin are not uncommon. They originate in the field of the otolaryngologist, and he should be equipped to treat these complications. He reviews some of the localizing signs of frontal, temporal, and cerebellar abscesses. Shuster believes that the surgical approach should be through the primary focus of infection after the necessary sinus or mastoid surgery has been performed. As soon as the abscess has localized, incision and drainage should be done, leaving a rubber drainage tube in place from two to four weeks. Antibiotics and sulfonamides are given in adequate dosage. Shuster believes that the surgeon should not wait for encapsulation of the abscess nor should the abscess be resected in toto later, as this causes too much destruction of brain tissue.

Elsen and associates [29] report four cases of otogenous intracranial complications, including thrombophlebitis of the lateral sinus (two cases), temporal subdural abscess (one case), purulent meningitis (two cases), extradural abscess of the posterior fossa (one case), and temporal lobe abscess (one case). They were treated with adequate sulfonamides and penicillin, mastoidectomy, and drainage of the intracranial collection of pus, with three recoveries and one death. They stress the necessity of early surgical treatment of the complication and of surgically eradicating the primary focus. The authors also point out the masking effect of antibiotics on these complications and the fact that these complications may form or progress while antibiotics are being given.

Chase [30] reports a case of chronic otitis media and mastoiditis in a 25-year-old man, complicated by temporosphenoidal lobe abscess. The treatment was first a radical mastoidectomy and sulfonamides. The brain abscess was drained later by King's technique through the squama of the temporal bone, uncapping the abscess cavity, inserting a Mickulicz drain, and allowing the abscess to herniate. The patient recovered uneventfully.

Chambers and Clark [31] present a case of cerebellar and subdural abscess in the posterior fossa of otogenic origin due to Proteus vulgaris. This complication was apparently precipitated by a head blow in a 16-year-old boy who had had chronic suppurative otitis media for several years. The patient was treated by a suboccipital craniotomy for incision and drainage of both abscesses and later by a radical mastoidectomy. High doses of streptomycin, penicillin, chlortetracycline,

sulfadiazine, and chloramphenicol were given. The recovery was complete.

MISCELLANEOUS

Siegler [32] reports an unusual case of meningocele presenting in the roof of the external auditory canal in a 28-year-old white man, following skull fracture several years previously. No surgical procedure was carried out because of the danger of meningitis and spinal-fluid leak. A meningocele in this location may be distinguished from an aural polyp by the presence of pulsation in a meningocele and by the ability to reduce the size of a meningocele with a probe.

Youngs and Peyton [33] report an interesting case of spontaneous cerebrospinal fluid rhinorrhea in a 29-year-old woman secondary to the Arnold-Chiari malformation. A Torkildsen procedure was performed, with improvement but not cure of the cerebrospinal rhinorrhea. The otorhinologist should be aware of this condition, as the rhinorrhea is occasionally the presenting complaint.

Moore [34] reviews the literature on intranasal encephalomeningocele and reports a case of this condition in a 20-month-old male child. The diagnosis was established by aspirating from the intranasal mass fluid which had the biochemical attributes of cerebrospinal fluid and by injecting ethyl iodophenylundecylate (Pantopaque) into the spinal canal, followed by appearance of the dye in the nasal mass on x-ray. The child was treated by intranasal excision of the mass, with, at the same time, closure of the dehiscence in the cribriform plate with tantalum gauze, absorbable gelatin sponge, and tantalum screen. There was an uneventful recovery. Moore emphasizes that no surgical manipulation should be instituted before diagnosis is established. Suggestive signs of nasal meningocele in a child are (*a*) abnormal width between the eyes and (*b*) a cystic polypoid mass in the nose with high attachment (mass may not pulsate and may not fluctuate in size).

Beyer and associates [35] report two cases of nasal meningocele. The first child had a frontal type of meningocele at the root of the nose. The second child, 23 months of age, had an intranasal meningocele occurring through a dehiscence in the cribriform plate. It was treated successfully by craniotomy, intracranial ligation of the pedicle, and closure of the dehiscence with a free pericranial graft. This, state the authors, is the treatment of choice, and they warn that aspiration of the intranasal mass and taking a biopsy specimen are dangerous procedures, because of the frequent occurrence of spinal-fluid leak or meningitis following such procedures.

Love and associates [36] report a rare case of cerebrospinal-fluid otorrhea in a 60-year-old woman following a suboccipital craniectomy for excision of a neurilemmoma of the cerebellopontine angle. One unsuccessful attempt at closure was made, followed by successful surgical closure, utilizing a polyvinylformal sponge over the lateral wall of the posterior fossa against the mastoid area.

Finerman and Pick [37] review the classification of encephalomeningoceles and the diagnostic signs of intranasal encephalomeningoceles. They report a case of intranasal encephalomeningocele in a 2-week-old infant, which was not diagnosed preoperatively. A biopsy specimen was taken first, followed by excision of the mass through a lateral rhinotomy approach. The dehiscence in the cribriform plate and the true nature of the mass were discovered at that time. A free graft of nasal mucosa was placed over the dehiscence; a pack was left in place, and the infant recovered completely, without developing meningitis.

Andrew [38] reports an interesting case of temporal lobe herniation through a defect in the tegmen into the mastoid antrum and external auditory canal in a 19-year-old boy. This lesion apparently resulted from a skull fracture 10 years previously. It was successfully treated through a temporal craniotomy, reducing the temporal lobe hernia, and covering the large tegmen defect with crushed temporal muscle and temporal fascia. Systemic penicillin, sulfadiazine, chlortetracycline, and streptomycin were given. The recovery was uneventful.

Cassidy and Wahl [39] report two cases (infants aged 4 months and 20 months) in which central nervous system tissue (principally glial elements and scattered ganglion cells) was present in nasal tumors. Both of these tumors apparently originated from the lateral wall of the nose near the mucocutaneous junction. There were no central connections of the tumors (as differentiated from encephalomeningoceles), and the authors were unable to classify the tumors. They feel that they represent embryonal cell rests or displaced neural tissue. Both tumors were excised intranasally, with good results. The authors emphasize the importance of differentiating such masses from encephalomeningoceles.

Fitz-Hugh [40] reviews the case history of a 5-year-old child who had a small intranasal encephalomeningocele. Despite the fact that the child had allergic rhinitis and the mass was excised on two occasions mistakenly for a nasal polyp and without antibiotic coverage, the child did not develop meningitis. Once the diagnosis was established by histological means, the mass was again removed intranasally, followed by intracranial repair of the dehiscence in the cribriform plate, with uneventful recovery of the child.

Font [41] reports two interesting cases of transient jugular foramen syndrome in which the patients (both men, aged 32 and 64 years) developed abrupt 9th, 10th, and 11th unilateral cranial nerve paralyses in the presence of an upper-respiratory infection. Both men had onsets with severe pain in the face. Because of the herpetic-like pain, the finding of a herpetic vesicle on the ventricular band of one patient, and the rapid clearing of the paralysis, the author attributes these transient jugular foramen syndromes to viral origin.

Hirsch [42] reports two cases of cerebrospinal-fluid rhinorrhea following transsphenoidal pituitary surgery. He describes a new procedure, by means of which the fistula may be closed endonasally. This was accomplished successfully in these two cases by swinging a mucoperichondrial flap from the nasal septum into the sphenoid cavity, the raw surface being placed along the floor of the sella and held in place by a petrolatum sponge. In one of the patients it was necessary to cauterize the floor of the sella and the mucoperichondrial flap with 50% silver-nitrate solution to stimulate healing.

Walker and associates [43] report the successful treatment of a very large intranasal encephalomeningocele with cerebrospinal-fluid rhinorrhea in a 4-week-old infant. It was necessary first to do a tracheotomy to alleviate respiratory distress. A frontal craniotomy was done in which the defect in the cribriform plate was closed with a dural flap mobilized from the orbital plate, this being covered with absorbable gelatin sponge. The intranasal mass was excised three months later, and recovery was complete. The authors point out that mortality in this condition may be reduced by (1) correct diagnosis; (2) avoiding intranasal procedures, which may result in spinal-fluid rhinorrhea or meningitis; (3) adequate chemotherapy, and (4) intracranial repair or the primary surgical procedure.

Druss [44] reviews the clinical and histopathological features of fractures of the petrous pyramid. In an unusual opportunity, he presents a detailed histopathological study of the temporal bone of a patient who sustained longitudinal and transverse fractures of the petrous bone eight years prior to his death of unrelated cause (pneumonia). He correlates these findings with the clinical picture.

Ames and associates [45] present an unusual case report of cerebrospinal rhinorrhea in a 6-year-old girl who sustained multiple injuries in an automobile accident. A linear fracture of the right occipital bone was seen on x-ray. Under general anesthesia the right Eustachian tube was catheterized, followed by the drainage of spinal fluid, proving that the spinal fluid originated from the middle ear and mastoid and not from the anterior fossa. A suboccipital craniotomy was performed, during which a large dural tear was discovered near the internal auditory meatus. This was covered with a free graft of pericranium and with an absorbable gelatin sponge pack.

The postoperative course was successful and uneventful.

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Directory of Otolaryngological Societies *

FOREIGN AND INTERNATIONAL

Canadian Otolaryngological Society
(Société Canadienne d'Otolaryngologie)

President: Dr. G. Edward Tremble, 1390 Sherbrooke St. West, Montreal, P. Q.
Secretary: Dr. G. Arnold Henry, 170 St. George St., Toronto.
Place: Bigwin Inn, Lake of Bays, Muskoka, Ont. Time: June 16-18, 1955.

International Bronchoesophagological Society

President: Dr. André Soulas, 184 Avenue Victor Hugo, Paris 16.
Secretary: Dr. Chevalier L. Jackson, 3401 N. Broad St., Philadelphia 40.

International Congress of Audiology

Place: Leyden, Netherlands.
General Secretary: Dr. H. C. Huizing, 182 Oostersingel, Groningen, Holland.

International Course in Paedo-Audiology

Place: Groningen, Netherlands.
General Secretary: Dr. H. C. Huizing, 182 Oostersingel, Groningen, Holland.

Pan-American Association of Oto-Rhino-Laryngology and Broncho-Esophagology

President: Dr. Juan Manuel Tato, Azcuenaga 235, Buenos Aires, Argentina.
Secretary: Dr. Chevalier L. Jackson, 3401 N. Broad St., Philadelphia 40.
Meeting: Fifth Pan-American Congres of Oto-Rhino-Laryngology and Broncho-Esophagology.
Place: San Juan, Puerto Rico. Time: February, 1956.
President of Congress: Dr. Juan H. Font, Medical Arts Building, San Juan.

Sixth International Congress of Otolaryngology

President: Dr. Arthur W. Proetz, 3720 Washington Blvd., St. Louis.
General Secretary: Dr. Paul H. Holinger, 700 N. Michigan Ave., Chicago 11.
Place: Hotel Statler, Washington, D. C. Time: May 5-10, 1957.

NATIONAL

American Medical Association, Scientific Assembly, Section on Laryngology, Otology and Rhinology

Chairman: Dr. Francis W. Davison, Geisinger, Memorial Hospital, Danville, Pa.
Secretary: Dr. Hugh A. R. Kuhn, 112 Rimbach St., Hammond, Ind.
Place: Atlantic City, N. J. Time: June 6-10, 1955.

American Academy of Ophthalmology and Otolaryngology

President: Dr. Algernon B. Reese, 73 E. 71st St., New York 21.
Executive Secretary-Treasurer: Dr. William L. Benedict, 100-1st Ave., Bldg., Rochester, Minn.
Place: Palmer House, Chicago. Time: Oct. 9-15, 1955.

* Secretaries of societies are requested to furnish the information necessary to keep this list up to date.

American Board of Otolaryngology

President: Dr. Frederick T. Hill, Professional Building, Waterville, Maine.
Secretary-Treasurer: Dr. Dean M. Lierle, University Hospitals, Iowa City.
Examinations: Palmer House, Chicago, October, 1955.

American Broncho-Esophagological Association

President: Dr. Clyde A. Heatly, 11 N. Goodman St., Rochester, N. Y.
Secretary: Dr. F. Johnson Putney, 1719 Rittenhouse Sq., Philadelphia 3.

American Laryngological Association

President: Dr. Bernard J. McMahon, 8230 Forsyth Blvd., Clayton 24, Mo.
Secretary: Dr. Harry P. Schenck, 326 S. 19th St., Philadelphia 3.

American Laryngological, Rhinological and Otological Society, Inc.

President: Dr. Kenneth M. Day, 121 University Place, Pittsburgh.
Secretary: Dr. C. Stewart Nash, 708 Medical Arts Bldg., Rochester 7, N. Y.

SECTIONS:

Eastern.—Chairman: Dr. Benjamin H. Shuster, 1824 Pine St., Philadelphia 3.
Southern.—Chairman: Dr. G. Slaughter Fitz-Hugh, 104 E. Market St., Charlottesville, Va.
Middle.—Chairman: Dr. James E. Croushore, 3001 W. Grand Blvd., Detroit.
Western.—Chairman: Dr. Victor Goodhill, 2007 Wilshire Blvd., Los Angeles.

American Otological Society, Inc.

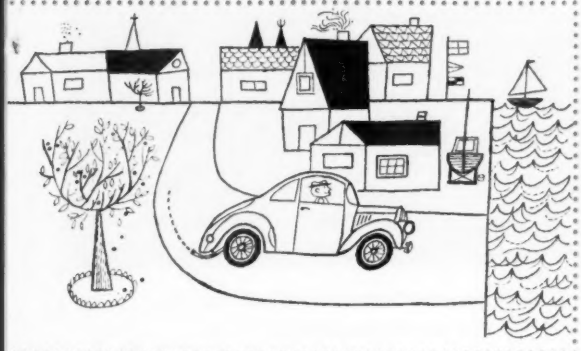
President: Dr. William J. McNally, 1509 Sherbrooke St. West, Montreal 25, Canada.
Secretary-Treasurer: Dr. Lawrence R. Boies, 90 S. Ninth St., Minneapolis 2.
Place: Mount Royal Hotel, Montreal, Canada. Time: May 11-12, 1956.

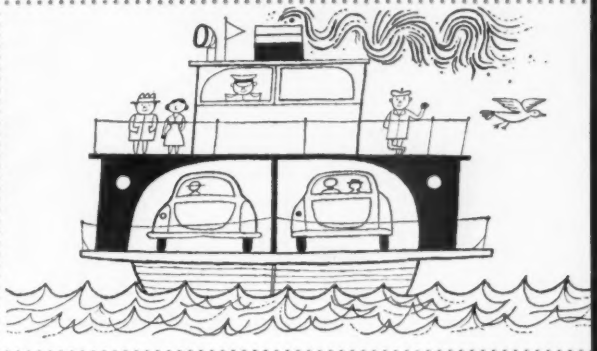
American Otorhinologic Society for the Advancement of Plastic and Reconstructive Surgery, Inc.

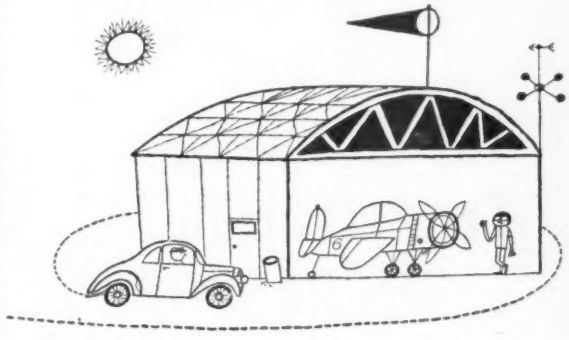
President: Dr. Joseph Gilbert.
Secretary: Dr. Louis Joel Feit, 66 Park Ave., New York 16.

American Society of Ophthalmologic and Otolaryngologic Allergy

President: Dr. F. Lambert McGannon, 14595 Madison Ave., Lakewood, Ohio.
Secretary-Treasurer: Dr. Michael H. Barone, 468 Delaware Ave., Buffalo 2.
Place: Palmer House, Chicago. Time: 1955.







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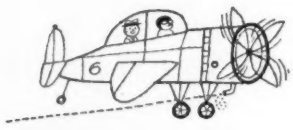

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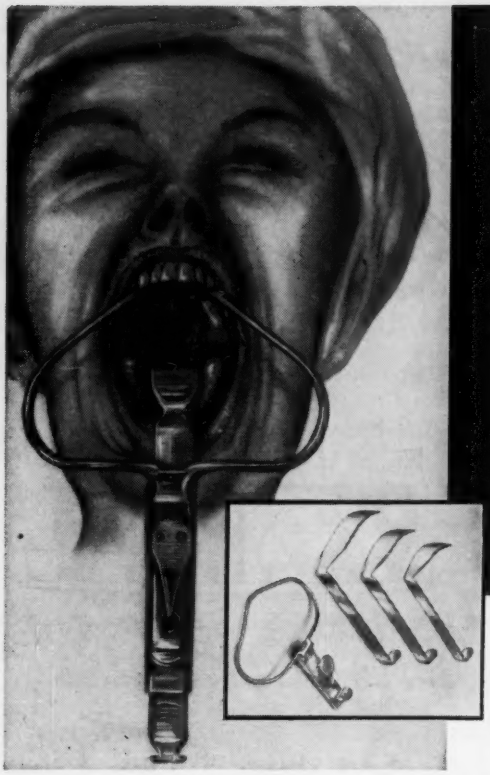

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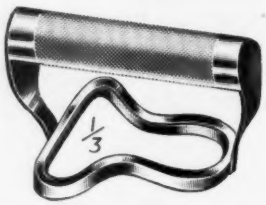

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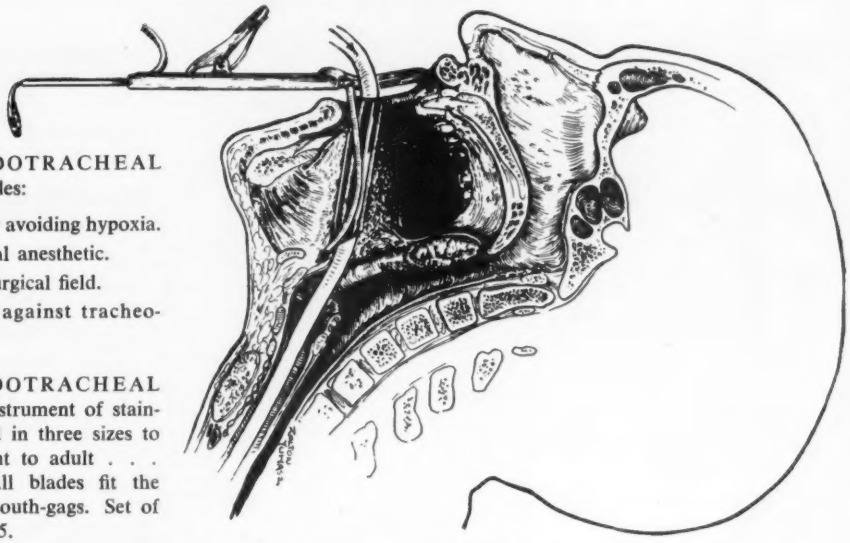

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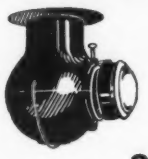

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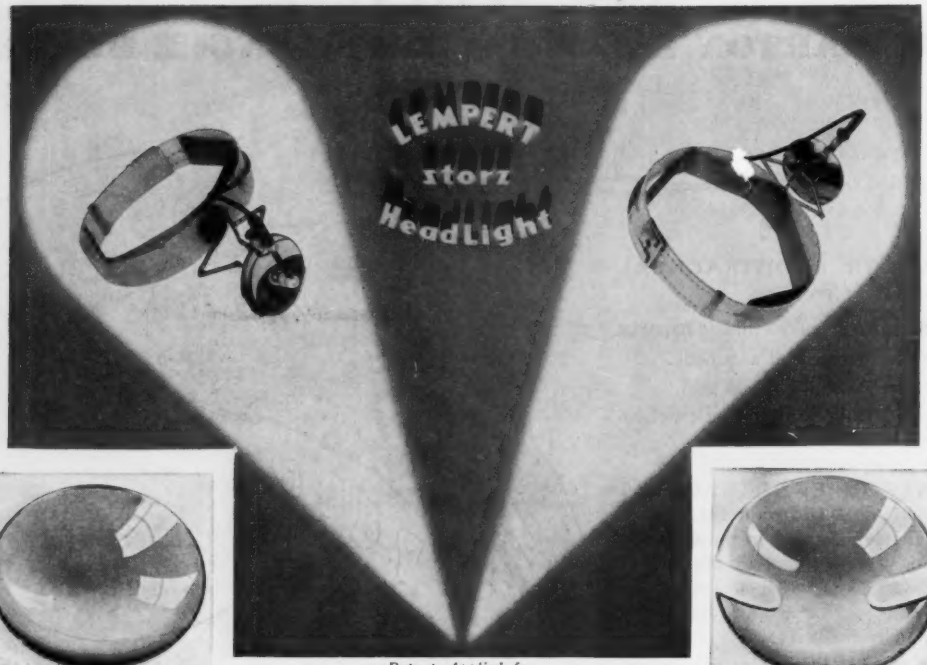
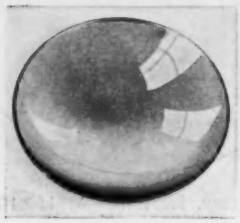
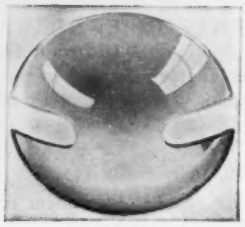


Patent Applied for

N-1000 N-1002



N-1006



N-1007

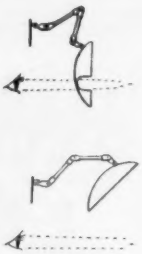
Headlight

ILLUMINATION is brilliant, shadow free and cavity filling.

MIRROR is specially ground, French made. Choice of full or double slotted, interchangeable, easily replaceable.

LAMP with heavy close wound filament produces ball of light which is reflected without filament shadow.

ADJUSTMENT of lamp by a spiral gear furnishes positive locked beam focusing which will not change when mirror is adjusted. Multiple arm mirror supports provides smooth, non slip directional setting of light beam.



Headband

MATERIAL IS NYLON. Tough, lightweight, non-staining, non-deteriorating.

ADJUSTMENT is simple, self locking and centered at back, equal reach for either hand.

SUSPENSION LINING eliminates pressure points. Washable and replaceable.

Transformer

Not illustrated

FIXED VOLTAGE, small, light weight.

CORDS total 18 feet from outlet to headlight. Outlet to transformer cord is 8 feet. Can be suspended from ceiling outlet if required. Transformer to headlight cord is 7 feet and is connected to 3 foot headband cord by positive snap lock plug.

INFORMATION FOR ORDERING

N-1000	Headlight, LEMPERT-STORZ: complete, with full mirror, transformer and extra lamp.	**$87.50**
N-1002	Headlight, LEMPERT-STORZ: complete, with slotted mirror, transformer and extra lamp.	**$91.50**
N-1004	Case, Carrying: for N-1000 and N-1002, but not included. Order separately if desired. Price upon request.	
N-1006	Mirror, Replacement, Full: for N-1000.	**$ 8.00**
N-1007	Mirror, Replacement, Slotted: for N-1002.	**$12.00**
N-1008	Lamp, Replacement: for N-1000 and N-1002.	**$ 1.25**
N-1010	Transformer, Fixed Voltage: as used with N-1000 and N-1002. Price upon request.	

N-1012

Storz Instrument Company

4570 Audubon Avenue St. Louis 10, Missouri

pedigree

Only a flawless pedigree — a long and illustrious ancestry of purebreds — can produce a champion show dog.

Only **audivox** in the hearing-aid field can trace an ancestry that includes both Western Electric and Bell Telephone Laboratories. **audivox** lineage springs from the pioneer experiments of Dr. Alexander Graham Bell, furthered by the development of the hearing aid at Bell Telephone Laboratories, brought to fruition by Western Electric and **audivox** engineers.

Alexander Graham Bell

audivox

Successor to *Western Electric* Hearing Aid Division
123 Worcester St., Boston, Mass.

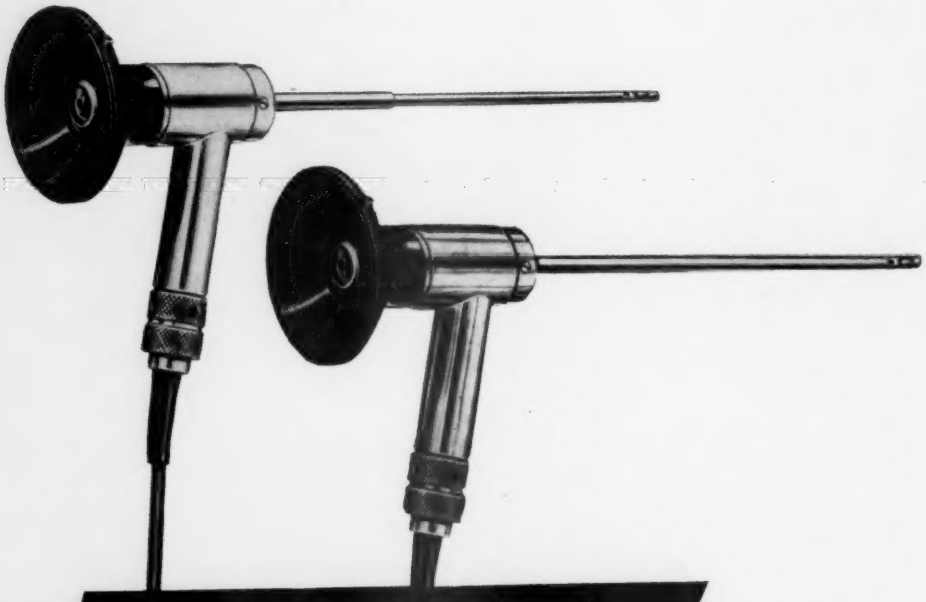
all-transistor
Model 72
by Audivox

new:

audivox presents a versatile new tool in the psychological and somatic management of hearing loss — the Model 72 "New World." Because it departs completely from conventional hearing-aid appearance, this tiny "prosthetic ear" may be worn as a barrette, tie clip, or clasp without concealment. Resultant benefits include new poise and new aural acuity for the wearer through free-field reception without clothing rustle.

MANY DOCTORS rely on career Audivox dealers for conscientious, prompt attention to their patients' hearing needs. There is an Audivox dealer — chosen for his interest, ability, and integrity — in your vicinity. He is listed in the Hearing Aid section of your classified telephone directory, under Audivox or Western Electric.

the pedigreed hearing aid.



a distinguished pair

No ordinary instruments are these two National Nasopharyngoscopes. Both have a quality of distinction that you will appreciate.

The moment you look through either instrument you will see that the whole field of vision is exceptionally bright, sharp, halo- and distortion-free to the very edge of the field.

National

Ask your Surgical Supply Dealer to show you National #5070 . . . Nasopharyngoscope, 11 Fr., with switch cord, 2 spare bulbs, bulb wax, in walnut case.

NATIONAL ELECTRIC INSTRUMENT CO., INC.,

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